NASA

Management
A Bibliography for NASA Managers

NASA SP-7500(22)
April 1988

National Aeronautics and
Space Administration

Management Management Management Management Management Management Management Management Management Management Management Management

This bibliography was prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by RMS Associates.

NASA SP-7500(22)

MANAGEMENT

A BIBLIOGRAPHY FOR NASA MANAGERS

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system during 1987.

NASA Scientific and Technical Information Division 1988
National Aeronautics and Space Administration
Washington, DC

This document is available from the National Technical Information Service (NTIS), Springfield, Virginia 22161, price code A08

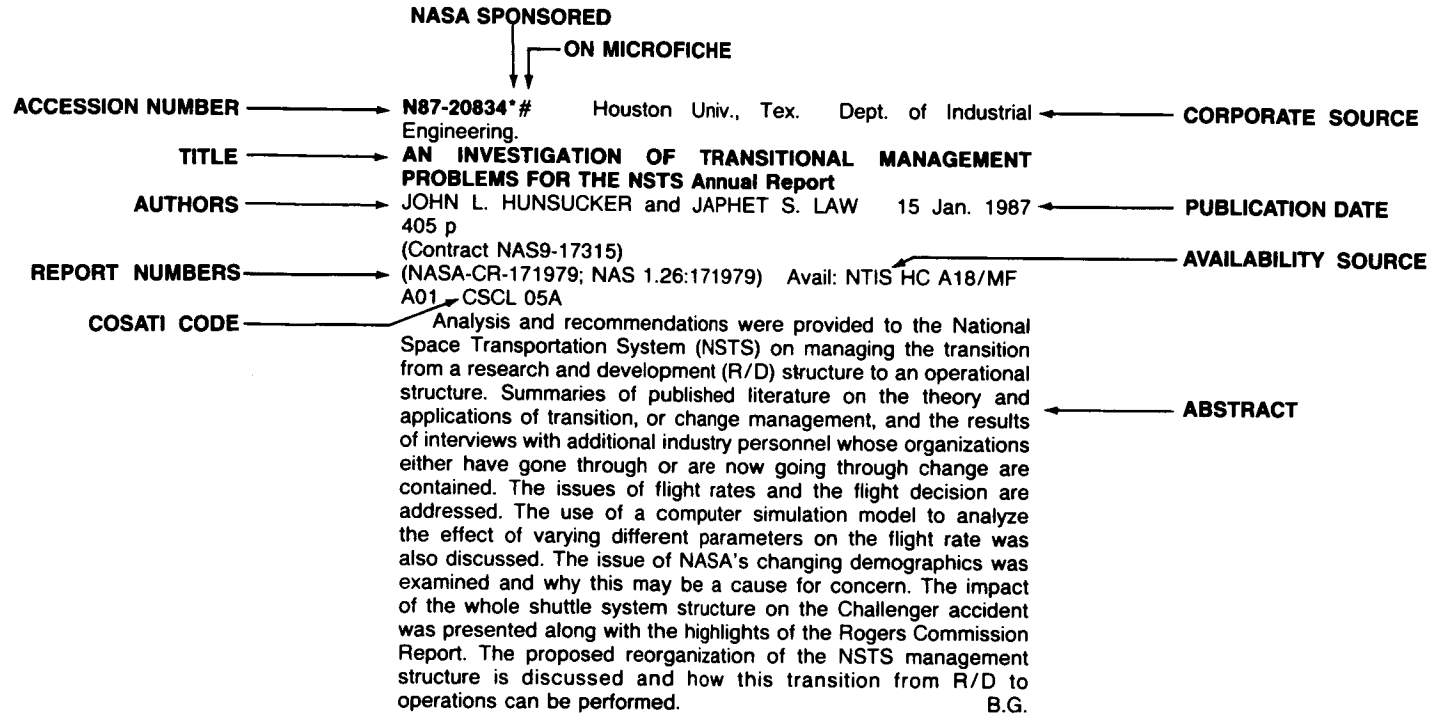
FOREWARD

Management gathers together references to pertinent documents — reports, journal articles, books — that will assist the NASA manager to be more productive. Items are selected and grouped according to their usefulness to the manager as *manager.* A methodology or approach applied to one technical area may be worthwhile for a manager in a different technical field.

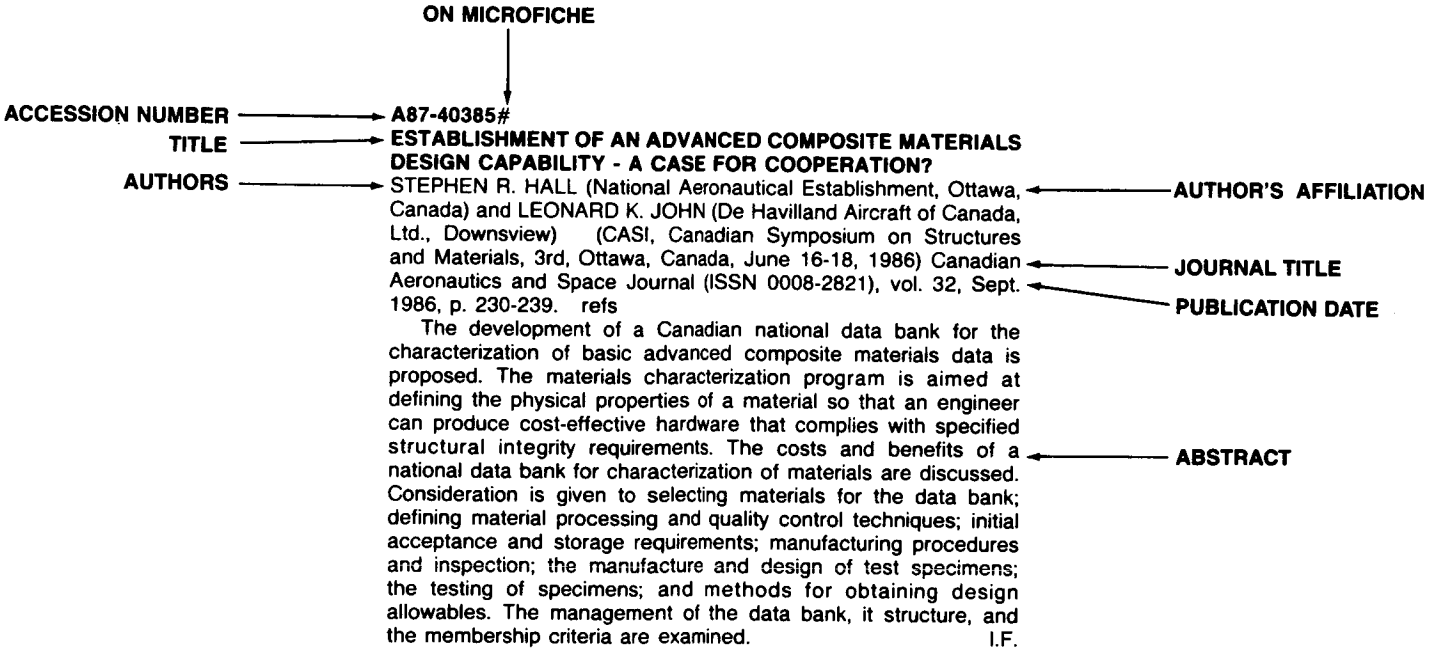
Individual sections can be quickly browsed. Indexes will lead quickly to specific subjects or items.

TABLE OF CONTENTS

TYPICAL REPORT CITATION AND ABSTRACT



TYPICAL JOURNAL ARTICLE AND ABSTRACT



MANAGEMENT

A Bibliography for NASA Managers

APRIL 1988

01

HUMAN FACTORS AND PERSONNEL ISSUES

Includes Organizational Behavior, Employee Relations, Employee Attitudes and Morale, Personnel Management, Personnel Development, Personnel Selection, Performance Appraisal, Training and Education, Computer Literacy, Human Factors Engineering, Ergonomics, Human-Machine Interactions.

A87-13551
FUNDAMENTALS OF AEROSPACE MEDICINE
R. L. DEHART, ED. (Industrial Medicine Employer's Service of Oklahoma, Inc.; Hillcrest Occupational Medicine Services, Tulsa; Oklahoma, University, Norman) Philadelphia, PA, Lea and Febiger, 1985, 1001 p. For individual items see A87-13552 to A87-13584.

A textbook is presented for the various facets of aviation, aerospace, and occupational health medicine. Consideration is given to the interaction of human physiology with aerospace environments and to research programs initiated to enhance the understanding and safety of this interaction. The procedures, health problems and maintenance, and training for practitioners of aviation medicine are explored in depth. M.S.K.

A87-13554
THE FUTURE PERSPECTIVE
G. C. MOHR (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: Fundamentals of aerospace medicine . Philadelphia, PA, Lea and Febiger, 1985, p. 41-59. refs

The areas of aerospace medicine requiring further investigation to respond to near-term increased capabilities of scientific, civil, and military aircraft and aerospacecraft are summarized. Hypersonic flight will expose crew and passengers to new atmospheric species, more intense radiation, and depressurization hazards. Aerospaceplanes will need self-contained air supplies, structural cooling methods, lightweight structures with enhanced strength, and advanced navigation systems. M.S.K.

A87-13583
OCCUPATIONAL MEDICAL SUPPORT TO THE AVIATION INDUSTRY
R. T. P. DETREVILLE (USAF, Occupational and Environmental Health Laboratory, Brooks AFB, TX) IN: Fundamentals of aerospace medicine . Philadelphia, PA, Lea and Febiger, 1985, p. 904-940. refs

Occupational health hazards, diagnostic techniques, treatment procedures and preventive measures of concern to aviation medicine specialists are reviewed. Professional organizations and publications established to enhance occupational health and safety are identified. Physical hazards germane to the aviation industry (noise; heat and cold; vibration; and electromagnetic, ionizing, and nonionizing radiation) are discussed, along with therapeutic, preventive and protective measures for injuries related to each type of hazard. M.S.K.

A87-16137*# National Aeronautics and Space Administration, Washington, D.C.
LUNAR SETTLEMENTS - A SOCIO-ECONOMIC OUTLOOK
B. J. BLUTH (NASA, Space Station Program Office, Washington, DC) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 5 p. refs
(IAF PAPER 86-513)

Factors in the design and development of a lunar settlement (LS) which affect the performance of the crew members are discussed. Topics examined include LS-program time constraints imposed by decisions made in developing and operating the Space Station; changes to make allowance for the long-term requirements of LSs; the design of the physical, technical, and organic LS environment; and the vital role of group dynamics in assuring LS success. It is suggested that many short-term cost-minimization strategies employed in spacecraft development may be inappropriate for LS programs. T.K.

A87-16813#
HUMAN FACTORS RESEARCH AND DEVELOPMENT REQUIREMENTS FOR FUTURE AEROSPACE COCKPIT SYSTEMS
R. J. SCHIFFLER and A. R. PINKUS (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3 . New York, Institute of Electrical and Electronics Engineers, 1986, p. 883-885.

Design requirements and technologies which will heavily influence human factors R&D in cockpit design in the 1990s are discussed. Trends towards integrated displays and controls, increased use of glass or solid-state displays, night vision goggles, laser/nuclear flashblindness protection, and helmet-mounted displays are noted. Pilots will use touch-screens, voice-activated systems and chord keyboards, and expert systems and AI-generated assistance and display control. Man-in-the-loop tests are required before finalizing integrated hardware/software designs. M.S.K.

A87-16821#
HUMANE INTELLIGENCE - A HUMAN FACTORS PERSPECTIVE FOR DEVELOPING INTELLIGENT COCKPITS
M. D. MCNEESE (USAF, Human Engineering Div., Wright-Patterson AFB, OH) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3 . New York, Institute of Electrical and Electronics Engineers, 1986, p. 941-948. refs

A human factors perspective for creating intelligent cockpits is described and explained. A conceptualized interface among the pilots, mental models, and human information technologies is proposed wherein knowledge concerning human cognition is meshed with the capabilities and limitations of artificial intelligence (AI). Necessarily, a different way of looking at the pilot's role in the intelligent cockpit is developed. Author

A87-17892#
PERSONAL COMPUTER UTILIZATION FOR ASSOCIATE CONTRACTOR MANAGEMENT VISIBILITY AND PRODUCTIVITY ENHANCEMENT
J. R. LOREN (Boeing Mojave Test Center, Edwards AFB, CA) AIAA, AHS, and ASEE, Aircraft Systems, Design and Technology Meeting, Dayton, OH, Oct. 20-22, 1986. 11 p.
(AIAA PAPER 86-2633)

A87-17952#
COMPUTER AIDED CREWSTATION INFORMATION ALLOCATION
M. E. ROWLAND and W. R. WAGONER (Boeing Military Airplane Co., Wichita, KS) AIAA, AHS, and ASEE, Aircraft Systems, Design and Technology Meeting, Dayton, OH, Oct. 20-22, 1986. 7 p.
(AIAA PAPER 86-2734)

The challenge of designing an effective operator oriented crewstation is being met with a new computer enhanced methodology. Using mission requirements as a spring board, this methodology synthesizes hardware, software, and Human Factors criteria, insuring that all needed mission capabilities are merged into a total Controls and Displays concept. The process was accomplished by developing a computer program which optimizes information allocation to display type and location and control type and location according to several critical parameters assigned by the designer. The result is a crewstation design which logically integrates the multiple outputs of sophisticated avionics in a way that allows high operator efficiency. Initial validation results indicate that the methodology provides a logical flow-down of information requirements into an integrated crewstation design. Author

A87-18471
HUMAN RELIABILITY WITH HUMAN FACTORS
B. S. DHILLON (Ottawa, University, Canada) New York, Pergamon Press, 1986, 258 p. refs

Techniques for taking human error into account when evaluating the reliability of technical systems are examined in an introductory test intended for engineering students and practicing engineers. Chapters are devoted to the history and basic terminology of human-reliability studies, the mathematical basis of fundamental concepts, human reliability and human error, human-reliability analysis methods, reliability evaluation of systems with human errors, human factors in maintenance and maintainability, human safety, human-reliability data, human factors in quality control, human factors in design, mathematical models, and applications of human-factors engineering. Diagrams, flow charts, graphs, and problems with solutions are provided. T.K.

A87-23450#
AN EXTERNAL MASTERS DEGREE PROGRAM IN AERONAUTICAL ENGINEERING THAT MEETS THE REQUIREMENTS OF BOTH INDUSTRY AND ACADEMIA
CONRAD F. NEWBERRY (California State Polytechnic University, Pomona) and BRIAN L. HUNT (Northrop Corp., Aircraft Div., Hawthorne, CA) AIAA, AHS, and ASEE, Aircraft Systems, Design and Technology Meeting, Dayton, OH, Oct. 20-22, 1986. 14 p. refs
(AIAA PAPER 86-2753)

A87-33153
AMERICAN WOMEN IN SPACE
ROGER WHEELER and PHILIP SNOWDON British Interplanetary Society, Journal (Pioneering Space) (ISSN 0007-084X), vol. 40, Feb. 1987, p. 81-88.

In 1983, 26 years into the Space Age, America flew its first female astronaut. Almost exactly 20 years earlier Russia had put a woman into orbit, but for the following decade, space had been a male-only preserve. The change in official attitude, which led to women becoming an accepted part of the U.S. Astronaut Program, is described and biographical details of the first 12 American women in space are given in an appendix. Author

A87-34596
MIXING ASTRONAUTS FROM MANY NATIONS BY THE U.S. ON SPACE SHUTTLE MISSIONS IS RESULTING IN A NEW VERSION OF THE MELTING POT.
JAY C. LOWNDES Commercial Space (ISSN 8756-4831), vol. 2, no. 4, Winter 1987, p. 34, 35, 38-40.

Test pilots, scientists and physicians form Britain, Canada, France, Indonesia, Mexico, the Netherlands, Saudi Arabia, and West Germany have overcome the rigors of astronaut training, the twists of politics, and the reaction of U.S. astronauts to become productive members of shuttle crews. Experiences and contributions of such foreign nationals as Ulf Merbold (West Germany), Marc Garneau (Canada), Patrick Baudry (France), Al-Saud (Saudi Arabia) are noted. Selection of payload specialists is now made not just on a technical basis by NASA, but often by foreign customers who develop the payload and sometimes by the President as a goodwill gesture. Details of training, limitations in responsibilities, and payload specialist status in the eyes of fellow astronauts are discussed. D.H.

A87-34598
RESEARCHERS ARE STUDYING HOW OUR BODIES REACT TO LONG STAYS IN A WEIGHTLESS ENVIRONMENT
LORETTA KETT BIERER Commercial Space (ISSN 8756-4831), vol. 2, no. 4, Winter 1987, p. 46-49.

Medical consequences of long-duration spaceflight are examined, including diminished capacity of heart and blood vessels, a tendency for blood to pool in the upper body in space and in the legs on return to earth, and the loss of calcium and other minerals from the weight-carrying bones. Of the problem areas defined by NASA for investigation, calcium metabolism and bone loss are likely to be the most important because the magnitude of the calcium loss from the body appears to be the deciding factor for the duration of the flight. Muscle atrophy and bone loss left Soviet cosmonauts of the 211-day Salyut 6/Soyuz mission in very weak condition. Experiments in which growing rats were exposed to weightlessness for 19 days, showed that the animals required about 25 days for adaptation to earth's gravity and for bone growth to begin again. Additional animal studies are reported, along with research into how weightlessness affects the bone remodelling process. NASA has targeted several areas for study: the time required for bone loss to plateau, the possibility of irreversible bone loss, the toxic effects of calcium and phosphorus released from bone on soft tissue (particularly the kidneys), and the potential for fracture. Efforts to prevent bone demineralization have concentrated on diet and exercise, as with a treadmill device. D.H.

A87-34703*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FLIGHT-VEHICLE STRUCTURES EDUCATION IN THE UNITED STATES ASSESSMENT AND RECOMMENDATIONS
AHMED K. NOOR and S. C. DIXON (NASA, Langley Research Center, Hampton, VA) AIAA, ASME, ASCE, and AHS, Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987. 22 p. refs
(AIAA PAPER 87-0978)

An assessment is made of the technical contents of flight-vehicle structures curricula at 41 U.S. universities with accredited aerospace engineering programs. The assessment is based on the technical needs for the new and projected aeronautical and space systems as well as on the likely characteristics of the aerospace engineering work environment. A number of deficiencies and areas of concern are identified and recommendations are presented for enhancing the effectiveness of flight-vehicle structures education. A number of government supported programs that can help aerospace engineering education are listed in the appendix. Author

A87-35600
WHEN THE DOCTOR IS 200 MILES AWAY
LES DORR, JR. Space World (ISSN 0038-6332), vol. X-3-279, March 1987, p. 33-36.

Severe medical problems which may be encountered by crewmembers during Space Station tours of duty are discussed, as are the capabilities planned for the Station Health Maintenance Facility (HMF). Heart muscles lose tone and mass during long periods in microgravity, and bones inexorably lose calcium in a demineralization process. An increasing frequency of humans spending long periods of time in space introduces the possiblity of occurrence of acute illnesses such as cardiovascular problems or kidney stones precipitating from bone calcium suspended in the blood. A prototype HMF has a defibrillator, ECG, pulse oximeter, patient restraints, CRT readouts, an IV system capable of long-term use, and exercise apparatus to offset the deconditioning effects of long-term spaceflight. All the equipment will be amenable to use by astronauts with paramedic training. M.S.K.

A87-38794*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
MICROGRAVITY INDUCED FLUID AND ELECTROLYTE BALANCE CHANGES
R. W. PHILLIPS (NASA, Johnson Space Center, Houston, TX; Colorado State University, Fort Collins) IN: Symposium on Microgravity Fluid Mechanics; Proceedings of the Winter Annual Meeting, Anaheim, CA, Dec. 7-12, 1986 . New York, American Society of Mechanical Engineers, 1986, p. 47, 48. refs

The effect of reduced gravity on the fluid and electrolyte balance in astronauts is discussed. The acquired data indicate an early and marked sodium and potassium loss and a negative water balance. The conditions in astronauts may be likened to the syndrome of inappropriate secretion of antidiuretic hormone, but the mechanisms by which weightlessness causes a continued negative water and electrolyte balance, after the early shifts have occurred, are not clear. It is suggested that a transient increase in the release of the atrial naturetic factor and the altered gastrointestinal function may play a role in the initial and continued fluid and electrolyte changes, respectively. I.S.

A87-43355#
AMERICAN ENGINEERING AND SCIENCE GRADUATE STUDENTS - A NEW MINORITY?
EARL H. DOWELL (Duke University, Durham, NC) (DukEngineer, Fall 1986) AIAA Student Journal (ISSN 0001-1460), vol. 25, Spring 1987, p. 16, 17.

The need for more American students in U.S. engineering Ph.D. degree programs is discussed. Consideration is given to the number of graduates with bachelor of science degrees in engineering that pursue other advanced degrees such as J.D.'s, M.B.A.'s, and M.D.'s, and the starting salary ranges in these professions. It is proposed that in order to increase the number of American students in engineering Ph.D. programs it it necessary to (1) provide special financial support, (2) use a 12-month industrial salary for engineering Ph.D's, and (3) have joint ventures between universities and industries. I.F.

A87-46871#
U.S. GOES BACK TO SCHOOL ON MANUFACTURING
YACOV A. SHAMASH (Washington State University, Pullman) and ERIK D. GOODMAN (Michigan State University, East Lansing) Aerospace America (ISSN 0740-722X), vol. 25, July 1987, p. 22, 23, 27.

The need to incorporate computer-aided engineering, design, and manufacturing into electrical, computer, and mechanical engineering curricula is examined. The benefits that will be provided to the manufacturing field by personnel trained in CAD/CAM are discussed. Various examples of the facilities and courses for CAD/CAM at some universities are presented. I.F.

A87-50573
THE SOVIET COSMONAUT TEAM - A COMPREHENSIVE GUIDE TO THE MEN AND WOMEN OF THE SOVIET MANNED SPACE PROGRAMME
GORDON R. HOOPER Woodbridge, England/San Diego, CA, GRH Publications/Univelt, Inc., 1986, 330 p.

The composition and history of the Soviet Cosmonaut Team are presented together with comprehensive biographies of each man and woman involved, their spaceflight assignments, callsigns, and time spent in space. Every cosmonaut who has flown since the first manned spaceflight by Yuri Gagarin on April 12, 1961 is included. Only brief descriptions of their missions are given as the purpose of this book is to concentrate on the lives and careers of the cosmonauts themselves. K.K.

A87-53089
HUMAN CAPABILITIES IN SPACE
BYRON K. LICHTENBERG (Payload Systems, Inc., Wellesley, MA) IN: The human quest in space; Proceedings of the Twenty-fourth Goddard Memorial Symposium, Greenbelt, MD, Mar. 20, 21, 1986 . San Diego, CA, Univelt, Inc., 1987, p. 183-194. (AAS PAPER 86-114)

The role of humans in space is discussed. The crew is concerned with flying the vehicle, operating experiments, participating in biomedical studies, and exploring outside the spacecraft. The use of the crew to construct large structures, such as the Space Station, in space and the functions of the crew on the Space Station are examined. I.F.

N87-11627# Rolls-Royce Ltd., Derby (England).
ENGINEERS: CAN THEY BE MANAGED?
G. WALKER 6 Mar. 1986 21 p Presented at Royal Aeronautical Society, Bristol, England, 21 Oct. 1985
(PNR-90307; ETN-86-98018) Avail: NTIS HC A02/MF A01

The advantages of involving engineers in management are discussed. Examples from the aerospace industry are used to illustrate these advantages. ESA

N87-12166*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
THE SPACE STATION: HUMAN FACTORS AND PRODUCTIVITY
D. J. GILLAN, M. J. BURNS, C. L. NICODEMUS, and R. L. SMITH 1986 9 p
(Contract NAS9-15800)
(NASA-CR-179905; NAS 1.26:179905) Avail: NTIS HC A02/MF A01 CSCL 05H

Human factor researchers and engineers are making inputs into the early stages of the design of the Space Station to improve both the quality of life and work on-orbit. Effective integration of the human factors information related to various Intravehicular Activity (IVA), Extravehicular Activity (EVA), and teletobotics systems during the Space Station design will result in increased productivity, increased flexibility of the Space Stations systems, lower cost of operations, improved reliability, and increased safety for the crew onboard the Space Station. The major features of productivity examined include the cognitive and physical effort involved in work, the accuracy of worker output and ability to maintain performance at a high level of accuracy, the speed and temporal efficiency with which a worker performs, crewmember satisfaction with their work environment, and the relation between performance and cost. B.G.

N87-19906# Air Force Human Resources Lab., Brooks AFB, Tex.
HUMAN FACTORS TECHNOLOGIES: PAST PROMISES, FUTURE ISSUES Final Technical Paper
EARL A. ALLUISI Dec. 1986 12 p
(AD-A174761; AFHRL-TP-86-40) Avail: NTIS HC A02/MF A01 CSCL 05E

Discussed are what are viewed as major issues confronting the human factors profession. The small size of the human factors work force, relative to the hardware/software engineering work

force, is fundamental to the several issues discussed: How can leverage be generated? How can computer technologies be used to make a leveraged impact on design? How can applicable data and databases be constructed or generated for the computer-based leverage needed? The paper addresses the resolution of these issues with some specific examples. GRA

N87-23144# Human Engineering Labs., Aberdeen Proving Ground, Md.
HUMAN FACTORS ENGINEERING DATA MANAGEMENT HANDBOOK Final Report
R. B. MCCOMMONS Mar. 1987 75 p
(AD-A179691; HEL-TM-6-87) Avail: NTIS HC A04/MF A01 CSCL 05B

For some time, serious concerns have existed regarding how the Government acquires data. The questions most frequently asked include, how much data should we buy, when should we ask for it, how should we use it, and how do we acquire it so it is both timely and useful? This document was written with the above concerns and questions in mind. It is intended for use by HEL and other personnel who are engaged in HFE program management activities in support of materiel acqusitions. The document is presented as guidance for determining data requirements and specifying and scheduling their timely delivery. Accordingly, the objectives are to provide a basic understanding of data acquisition as part of the materiel development process. It should be considered a living document and, after evaluation and/or implementation by users, one which will be updated or modified, as required, to reflect field experience and changes in relevant policy. Last, while written from an HFE perspective, the author recognizes that HFE is most properly considered not as a discipline in and unto itself, but as a predominant element of the much larger initiative called MANPRINT (Manpower and Personnel Integration). GRA

N87-24882*# Johns Hopkins Univ., Baltimore, Md. School of Medicine.
BEHAVIORAL AND BIOLOGICAL INTERACTIONS WITH SMALL GROUPS IN CONFINED MICROSOCIETIES Final Report
JOSEPH V. BRADY Nov. 1986 39 p
(Contract NAG2-139)
(NASA-CR-181012; NAS 1.26:181012) Avail: NTIS HC A03/MF A01 CSCL 05I

Research on small group performance in confined microsocieties was focused upon the development of principles and procedures relevant to the selection and training of space mission personnel, upon the investigation of behavioral programming, preventive monitoring and corrective procedures to enhance space mission performance effectiveness, and upon the evaluation of behavioral and physiological countermeasures to the potentially disruptive effects of unfamiliar and stressful environments. An experimental microsociety environment was designed and developed for continuous residence of human volunteers over extended time periods. Studies were then undertaken to analyze experimentally: (1) conditions that sustain group cohesion and productivity and that prevent social fragmentation and performance deterioration, (2) motivational effects performance requirements, and (3) behavioral and physiological effects resulting from changes in group size and composition. The results show that both individual and group productivity can be enhanced under such conditions by the direct application of contingency management principles to designated high-value tasks. Similarly, group cohesiveness can be promoted and individual social isolation and/or alienation prevented by the application of contingency management principles to social interaction segments of the program. M.G.

N87-25723 Defence Research Information Centre, Orpington (England).
SHIFT WORK AND BIOLOGICAL RHYTHMS
J. RUTENFRANZ Nov. 1986 19 p Transl. into ENGLISH from Arzneimittel-Forschung/Drug Research no. 28 (2), (West Germany), v. 10a, 1978 p 1867-1872
(DRIC-T-7825; BR101102; ETN-87-99827) Avail: Issuing Activity

Technological, economic, and social reasons for the introduction of shift work are reviewed. The extent of its use and its effect on the health of workers are discussed. Some 10% to 20% of shift workers suffer illness, mainly of the gastrointestinal tract, and a larger number experience feelings of ill health, principally sleep disorders and food intake disorders. These effects are attributed to individual predisposition, the disturbance of sleep by noise on the day after night work, and difficulties in adapting biological functions to changes in the times of work and sleep. ESA

N87-25734# Joint Publications Research Service, Arlington, Va.
USSR REPORT: SPACE BIOLOGY AND AEROSPACE MEDICINE, VOLUME 21, NO. 1, JANUARY - FEBRUARY 1987
O. G. GAZENKO, ed. 29 Apr. 1987 153 p Transl. into ENGLISH of Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 1, Jan. - Feb. 1987 96 p
(JPRS-USB-87-003) Avail: NTIS HC A08/MF A01

Various topics in the fields of space biology and aerospace medicine are discussed. Aviation physiology, work capacity, pilot performance, blood chemistry, weightlessness effects, altitude and motion sickness, radiation damage, and the spectral rendition of vestibular nystagmus are among the topics covered.

N87-25736# Joint Publications Research Service, Arlington, Va.
PROBLEMS OF ASSESSING HUMAN FUNCTIONAL CAPACITIES AND PREDICTING HEALTH STATUS
S. G. SALIVON *In its* USSR report: Space Biology and Aerospace Medicine, Volume 21, No. 1, January - February 1987 p 12-18 29 Apr. 1987 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 1, Jan. - Feb. 1987 p 12-17
Avail: NTIS HC A08/MF A01

Reports dealing with assessments of human functional capabilities and health prediction are reviewed. Emphasis is placed on a systemic approach to the study of the functional abilities of the healthy man and prediction of his health status. Interactions in the man-environment system and hierarchical patterns of the regulation of various functional systems are considered. Author

N87-25884*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)/AMERICAN SOCIETY FOR ENGINEERING EDUCATION (ASEE) SUMMER FACULTY FELLOWSHIP PROGRAM, 1986, VOLUME 2
BAYLISS MCINNIS, ed. (Houston Univ., Tex.) and STANLEY GOLDSTEIN, ed. Jun. 1987 286 p
(Contract NGT-44-005-803)
(NASA-CR-171984-VOL-2; NAS 1.26:171984-VOL-2) Avail: NTIS HC A13/MF A01 CSCL 05A

The Johnson Space Center (JSC) NASA/ASEE Summer Faculty Fellowship Program was conducted by the University of Houston and JSC. The ten week program was operated under the auspices of the American Society for Engineering Education (ASEE). The basic objectives of the program are (1) to further the professional knowledge of qualified engineering and science faculty members; (2) to stimulate an exchange of ideas between participants and NASA; (3) to enrich and refresh the research and teaching activities of participants' institutions; and (4) to contribute to the research objectives of the NASA Centers. Each faculty fellow spent ten weeks at JSC engaged in a research project commensurate with his interests and background and worked in collaboration with a NASA/JSC colleague. The final reports on the research projects are presented. This volume, 2, contains sections 15 through 30.

N87-25898*# Prairie View Agricultural and Mechanical Coll., Tex.
AFFIRMATIVE ACTION AS ORGANIZATION DEVELOPMENT AT THE JOHNSON SPACE CENTER
MFANYA DONALD L. TRYMAN *In* NASA. Lyndon B. Johnson Space Center, National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1986, Volume 2 34 p Jun. 1987
Avail: NTIS HC A13/MF A01 CSCL 05A

The role of affirmative actions is investigated as an interventionist Organization Development (OD) strategy for insuring equal opportunities at the NASA/Johnson Space Center. In doing so, an eclectic and holistic model is developed for the recruiting and hiring of minorities and females over the next five years. The strategy, approach, and assumptions for the model are quite different than those for JSC's five year plan. The study concludes that Organization development utilizing affirmative action is a valid means to bring about organizational change and renewal processes, and that an eclectic model of affirmative action is most suitable and rational in obtaining this end. Author

N87-27386# Rochester Univ., N. Y. Center for Visual Science.
COMPUTATIONAL MODELS IN HUMAN VISION SYMPOSIUM (15TH) HELD ON JUNE 19-21, 1986 IN ROCHESTER, NEW YORK Final Report, 1 Feb. - 31 Mar. 1987
MARY M. HAYHOE and JEROME FELDMAN 31 Mar. 1987 168 p Symposium held in Rochester, N.Y., 19-21 Jun. 1986
(Contract AF-AFOSR-0118-86)
(AD-A181270; AFOSR-87-0607TR) Avail: NTIS HC A08/MF A01 CSCL 06D

This is a collection of abstracts and papers from a symposium on Computational Models in Human Vision held at the Center for Visual Science in June of 1986. Recently, a number of significant contributions to understanding human vision have come from the field of Artificial Intelligence. This influence is changing the scope and nature of the study of vision. The aim of the symposium was to crystallize this trend for the community of visual scientists, to review its contribution to the study of human vision, and to promote communication between vision scientists in neurophysiology, psychophysics, perception and computer vision. Papers were presented on: motion, color, texture, shape and form, space, and contextual effects and attention. These are all areas in which there has been significant computational work, and the abstracts in this collection reflect the current state of the field. GRA

N87-27398*# Texas Univ., Austin. Dept. of Psychology.
HUMAN PERFORMANCE IN AEROSPACE ENVIRONMENTS: THE SEARCH FOR PSYCHOLOGICAL DETERMINANTS
ROBERT L. HELMREICH and JOHN A. WILHELM 1987 35 p
(Contract NCC2-286)
(NASA-CR-180326; NAS 1.26:180326) Avail: NTIS HC A03/MF A01 CSCL 05I

A program of research into the psychological determinants of individual and crew performance in aerospace environments is described. Constellations of personality factors influencing behavior in demanding environments are discussed. Relationships between attitudes and performance and attitudes and personality are also reported. The efficacy of training in interpersonal relations as a means of changing attitudes and behavior is explored along with the influence of personality on attitude change processes. Finally, approaches to measuring group behavior in aerospace settings are described. Author

N87-29363*# Old Dominion Univ., Norfolk, Va.
NASA/AMERICAN SOCIETY FOR ENGINEERING EDUCATION (ASEE) SUMMER FACULTY FELLOWSHIP PROGRAM 1987
SURENDRA N. TIWARI, comp. Sep. 1987 141 p
(Contract NGT-47-003-029)
(NASA-CR-178368; NAS 1.26:178368) Avail: NTIS HC A07/MF A01 CSCL 05C

Since 1964, NASA has supported a program of summer faculty fellowships for engineering and science educators. In a series of collaborations between NASA research and development centers and nearby universities, engineering faculty members spend 10 or 11 weeks working with professional peers on research. The Summer Faculty Program Committee of the American Society for Engineering Education supervises the programs. Objectives: (1) to further the professional knowledge of qualified engineering and science faculty members; (2) to stimulate and exchange ideas between participants and NASA; (3) to enrich and refresh the research and teaching activities of participants' institutions; (4) to contribute to the research objectives of the NASA center. Program Description: College or university faculty members were appointed as Research Fellows to spend 10 weeks in cooperative research and study at the NASA Langley Research Center. The Fellow devoted approximately 90 percent of the time to a research problem and the remaining time to a study program. The study program consisted of lectures and seminars on topics of interest or that are directly relevant to the Fellows' research topic. Author

02

MANAGEMENT THEORY AND TECHNIQUES

Includes Management Overviews and Methods, Decision Theory and Decision Making, Leadership, Organizational Structure and Analysis, Systems Approaches, Operations Research, Mathematical/Statistical Techniques, Modelling, Problem Solving, Management Planning.

A87-10041* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
INFLUENCES ON CORPORATE EXECUTIVE DECISION BEHAVIOR IN GOVERNMENT ACQUISITIONS
J. R. WETHERINGTON (NASA, Kennedy Space Center, Cocoa Beach, FL) IN: Space Congress, 23rd, Cocoa Beach, FL, April 22-25, 1986, Proceedings . Cape Canaveral, FL, Canaveral Council of Technical Societies, 1986, p. 6-15 to 6-28. refs

This paper presents extensive exploratory research which had as its primary objective, the discovery and determination of major areas of concern exhibited by U.S. corporate executives in the preparation and submittal of proposals and bids to the Federal government. The existence of numerous unique concerns inherent in corporate strategies within the government market environment was established. A determination of the relationship of these concerns to each other was accomplished utilizing statistical factor analysis techniques resulting in the identification of major groupings of management concerns. Finally, using analysis of variance, an analysis and discovery of the interrelationship of the factors to corporate demographics was accomplished. The existence of separate and distinct concerns exhibited by corporate executives when contemplating sales and operations in the government marketplace was established. It was also demonstrated that quantifiable relationships exist between such variables and that the decision behavior exhibited by the responsible executives has an interrelationship to their company's demographics. Author

A87-11803#
AN INSIDER'S OVERVIEW OF THE NAS MANAGEMENT PROCESS
F. L. FRISBIE (FAA, Washington, DC) IN: Radio Technical Commission for Aeronautics, Annual Assembly Meeting and Technical Symposium, Washington, DC, November 19-21, 1985, Proceedings . Washington, DC, Radio Technical Commission for Aeronautics, 1985, p. 49-64.

Management techniques being applied in the process of achieving the goals of the $11.7 billion National Airspace System Plan in a 10 yr period are described. The program is under the coordination of an FAA Program Director and is being implemented as a joint program between the prime contractor, Martin-Marietta, and the engineering branch of the FAA. The aerospace company is managed by personnel accustomed to strict, computerized

cost-control projects. A hierarchical structure, which required predefinition of all subprogram means, methods and costs, was established to guide the integration of private and institutional project engineering procedures and ensure efficient work on the project. The distribution of the management and engineering authority to various departments and levels of the partnership are summarized, including venues by which the baseline configuration can be changed. M.S.K.

A87-16076*# Pennsylvania State Univ., University Park.
PREDICTING THE EARTH'S FUTURE
J. A. DUTTON (Pennsylvania State University, University Park) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 9 p. refs
(Contract NAS8-36150)
(IAF PAPER 86-406)

The development of earth system models that will simulate the past and present and provide predictions of future conditions is essential now that human activities have the potential to induce changes in the planetary environment. Critical aspects of global change include its pervasiveness and ubiquity, its distribution in several distinct time-scale bands, and the interactions between the atmosphere, ocean, land surface, and the terrestrial and marine biospheres. A model of the earth system on the scale of decades to centuries, developed by the Earth System Science Committee (NASA) with the strategy of dividing by time scale rather than discipline, is presented and the requirements for observations to support the implementation of the model are reviewed. Author

A87-16999
THE CONTRIBUTION OF THE GROUP PROCESS TO SUCCESSFUL PROJECT PLANNING IN R&D SETTINGS
J. A. KERNAGHAN and R. A. COOKE (Illinois, University, Chicago) IEEE Transactions on Engineering Management (ISSN 0018-9391), vol. EM-33, Aug. 1986, p. 134-140. refs

There are very few empirical studies in the project management and R&D literature comparing the relative effectiveness of groups versus individuals in developing a project plan. This study focuses on this issue and two aspects of planning effectiveness - quality and acceptance. Members of 80 groups completed a simulation, the Project Planning Situation, first individually and then as interacting groups. The results show that the quality of the project plans developed by the groups was significantly higher than the average quality of the plans developed by members working independently. The groups' plans also were better than those that were derived through nominal techniques. It is open to question, however, whether the group's plans were always superior to those of their 'best members'. The effectiveness of the groups in planning is related to the two basic elements of group process - rational and interpersonal. The rational elements of process determined the quality of the plan and the interpersonal factors were associated with the groups' acceptance of the project plan. Author

A87-17000
DELPHIC GOAL PROGRAMMING (DGP) - A MULTI-OBJECTIVE COST/BENEFIT APPROACH TO R&D PORTFOLIO ANALYSIS
R. KHORRAMSHAHGOL (North Carolina Central University, Durham) and Y. GOUSTY (Aix-Marseille III, Universite, Marseille, France) IEEE Transactions on Engineering Management (ISSN 0018-9391), vol. EM-33, Aug. 1986, p. 172-175. refs

This paper aims at developing a systematic way for allocating resources among different R&D projects in a multiple objective environment. For this purpose Delphic Goal Programming (DGP) is proposed as follows. Initially, a Delphi inquiry is conducted to identify the objectives to be considered in problem formulation. Successive rounds of Delphi will then be utilized to prioritize these objectives, determine their relative weights and the aspiration level for each objective. Finally, through Delphi inquiry, a portfolio of R&D projects to achieve these objectives, will be identified. The results of the Delphi inquiry will be used to build a goal programming model. This model then provides an allocation pattern for projects to achieve organizational objectives. Author

A87-20214#
ESA'S EXPERIENCE IN USING INCENTIVES AS A MANAGEMENT TOOL
W. THOMA (ESA, Contracts Dept., Paris, France) ESA Bulletin (ISSN 0376-4265), no. 47, Aug. 1986, p. 49-51.

Incentive provisions are much more widely applied in contracts in the USA than in Europe, where ESA is one of their main proponents, with some twenty years of experience in this domain. Incentive clauses are used as a management tool in the majority of ESA projects. A number of the Agency's service contracts also contain incentive clauses, tying the profit margins applicable to the quality of the services rendered. Author

A87-21804* Los Alamos National Lab., N. Mex.
SETTLEMENT OF THE MOON AND VENTURES BEYOND
PAUL W. KEATON (Los Alamos National Laboratory, NM) IN: Space nuclear power systems 1985; Proceedings of the Second Symposium, Albuquerque, NM, Jan. 14-16, 1985. Volume 3 . Malabar, FL, Orbit Book Co., Inc., 1987, p. 27-32. NASA-sponsored research. refs

The formation of a permanent base on the moon following the establishment of the Space Station is proposed. The characteristics of the moon which make it advantageous for exploration and as a base are described. Consideration is given to lunar resources, the solar flare problem, and the cost of developing a moon base. I.F.

A87-22553*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE STATION OVERVIEW
CARMINE E. DE SANCTIS, C. C. PRIEST, and W. V. WOOD (NASA, Marshall Space Flight Center, Huntsville, AL) AIAA, Aerospace Sciences Meeting, 25th, Reno, NV, Jan. 12-15, 1987. 12 p. refs
(AIAA PAPER 87-0315)

This paper presents an overview of the Space Station, including program guidelines, international involvement, current baseline configuration, and utilization for science and application missions. Space Station configuration and capabilities, plus methods of utilizing the Space Station for scientific and engineering investigations, are described. The Space Station is being designed as a multipurpose facility to support a number of functions, such as a laboratory in space, a transportation node, an assembly facility, a staging base, etc. The description includes the baseline configuration, location of the pressurized modules, servicing and assembly facilities, and the work package structure for Space Station management. The Space Station will accommodate a wide variety of user requirements in laboratory modules and as attached payloads. To show the utility of the Space Station, a variety of science and application missions currently being studied for NASA at the Marshall Space Flight Center are discussed. Author

A87-24650
A QUICK LOOK AT MATRIX ORGANIZATION FROM THE PERSPECTIVE OF THE PRACTICING MANAGER
JAMES W. LAWSON (U.S. Navy, Technical Div., Bayonne, NJ) Engineering Management International (ISSN 0167-5419), vol. 4, Oct. 1986, p. 61-70. refs

A review of the literature concerning matrix organization, to provide guidelines for the practicing manager, indicates that little consensus is reached as to what constitutes matrix organization. Though there is a lack of universality concerning matrix strengths and weaknesses, agreement on strengths focused on the matrix providing increased market responsiveness, and better coordination and policy decisions, and agreement on weaknesses focused on personal dissatisfaction and difficulties in adjusting to different managerial styles in regard to setting priorities. Also, significant flaws in logic were found in this literature. R.R.

A87-25438
SPACE GENIUSES WANTED - APPLY JPL
STEPHAN WILKINSON Air and Space (ISSN 0886-2257), vol. 1, Dec. 1986-Jan. 1987, p. 65-74.

An introductory account is given of the history, institutional character and current research work of NASA's Jet Propulsion Laboratory, founded by Theodor von Karman in the late 1930s. Attention is given to the work environment supporting intensive collaborative efforts among researchers, as well as the backgrounds and motivations of representative scientists currently involved in satellite and space probe design and construction. Milestones in rocket development at JPL are noted. O.C.

A87-27925
ORGANIZATIONAL STRUCTURE, INFORMATION TECHNOLOGY, AND R&D PRODUCTIVITY
THOMAS J. ALLEN (MIT, Cambridge, MA) IEEE Transactions on Engineering Management (ISSN 0018-9391), vol. EM-33, Nov. 1986, p. 212-217. refs

To improve R&D productivity and performance, two types of communication must be managed properly. First, there is communication which is required to coordinate the many complex tasks and subsystem interrelations that exist on an R&D project. Second, there is communication which insures that the technical staff of the project remain current. Organizational structure can be employed to achieve either of these goals. Since different structures are needed for the two, it is important to consider the situations in which one or the other dominates. A tradeoff is necessary. Project organization facilitates task and subsystem coordination. Functional organization connects engineers more effectively to the technologies upon which they draw. The manager must determine the situations in which one or the other goal dominates and employ the organizational structure appropriate to that goal. The present paper provides three parameters which can be used to characterize project situations and guide the decision on organizational form. In addition, there is the possibility that improvements in information technology will be able to substitute for one of the two organizational forms and allow greater use of the other, thereby easing the organizational tradeoff.
Author

A87-28353
AN EXAMINATION OF DISTRIBUTED PLANNING IN THE WORLD OF AIR TRAFFIC CONTROL
NICHOLAS V. FINDLER and RON LO (Arizona State University, Tempe) Journal of Parallel and Distributed Computing (ISSN 0743-7315), vol. 3, Sept. 1986, p. 411-431. refs
(Contract DOT-RS-5863-C-00001)

The present consideration of a distributed planning system network for ATC addresses the questions as to the way that individual processors should be interconnected to fully utilize their capabilities, as well as the manner of planning activity that those individual processors should engage in. Attention is presently given to results obtained with a location-center cooperative mode operation organizational architecture, which is demonstrated by a simulation-based planning process. The general goal of this system is the delegation of greater ATC responsibilities to computers.
O.C.

A87-34870
INNOVATIONS IN SPACE MANAGEMENT - MACROMANAGEMENT AND THE NASA HERITAGE
PHILIP R. HARRIS (Harris International, La Jolla, CA) British Interplanetary Society, Journal (Space Chronicle) (ISSN 0007-084X), vol. 40, March 1987, p. 109-116. refs

Under the leadership of NASA and the National Commission on Space, plans are underway for the next 25 to 50 years in space developments. At the minimum, it involves space and lunar stations that will be complicated to construct and manage, require a new generation of technology, and cost billions of dollars. From these bases in space, planners envision the mining of the moon, then the asteroids, and eventually manned missions to Mars. For such to happen will require an organizational transformation of the National Aeronautics and Space Administration. This may involve changes that give the agency more autonomy and flexibility, especially for long-term financing. Certainly, it should include planned organization renewal so that NASA builds upon the technological and management innovations of its Apollo heritage. To become metaindustrial organizations, NASA and its aerospace partners will have to create a new work culture. For that purpose, the first step should be a survey and assessment of their contemporary organizational culture, so as to ascertain what changes are necessary for future space management. For NASA, the management changes involve new relationships with the military and private sector, as well as with international space consortia and possibly some new entities, such as a global space agency.
Author

A87-35446
AN EXTENSION OF THE ANALYTIC HIERARCHY PROCESS FOR INDUSTRIAL R&D PROJECT SELECTION AND RESOURCE ALLOCATION
MATTHEW J. LIBERATORE (Villanova University, PA) IEEE Transactions on Engineering Management (ISSN 0018-9391), vol. EM-34, Feb. 1987, p. 12-18. Research supported by Villanova University. refs

The research and development project selection decision is concerned with the allocation of resources to a set of proposals for scientific and engineering activities. The project selection and resource allocation process can be viewed as a multiple-criteria decision-making problem, within the context of the long-range and strategic planning process of the firm. The purpose of this paper is to explore the applicability of an extension of the Analytic Hierarchy Process (AHP) for priority setting and resource allocation in the industrial R&D environment. In this paper, an AHP modeling framework for the R&D project selection decision is developed, and is linked to a spreadsheet model to assist in the ranking of a large number of project alternatives. Next, cost-benefit analysis and integer programming are used to assist in the resource allocation decision. The paper concludes with an evaluation of the suitability of this approach as an expert support system, and directions for future research and testing. Author

A87-35447
R&D MANAGEMENT AND ORGANIZATIONAL COUPLING
NANETTE S. LEVINSON (American University, Washington, DC) and DAVID D. MORAN (George Washington University, Washington, DC) IEEE Transactions on Engineering Management (ISSN 0018-9391), vol. EM-34, Feb. 1987, p. 28-35. refs

Recent studies of excellent R&D management have highlighted the management of loose and tight elements - of change and continuity. Building on these studies, this paper reports on a comprehensive review of the literature and an in-depth study of an R&D laboratory including a series of twenty-nine detailed interviews with research performers and research managers. It presents a strategic approach to enhancing R&D management. This approach focuses on five coupling patterns: linkages of elements within the stages of the R&D cycle; linkages of specific stages of the R&D cycle; linkages across organizational levels; linkages with organizations in a laboratory's environment; and linkages between R&D performers and mentors. These linkages constitute connections across which information moves. Managing this information transfer and achieving the appropriate balance of loose and tight coupling is one of the most significant activities in R&D management. What works is careful and creative attention to existing and needed levels of intensity, rigidity, and freedom throughout the stages of the R&D process. Author

A87-37969
EFFECTS OF THE LONG-TERM ESA PROGRAMME ON EMPLOYMENT
Space Policy (ISSN 0265-9646), vol. 3, Feb. 1987, p. 52-64.
(Contract ESA-5983/84/F/FL)

The effects of the long-term ESA program on employment within and outside the space sector are investigated. The number of people employed in the space industry and supporting fields by

1983 was calculated as a total of 49,000 jobs with 22,000 in the space industry, 9000 in institutions and laboratories, and 18,000 in nonspace industries. Projected employment figures for 1988 reveal a 62 percent increase over 1983 figures; a total of 80,000 jobs with 39,000 in the space industry, 12,000 in institutions and laboratories, and 29,000 nonspace related. The growth in productivity to be provided by the work force is evaluated. Consideration is given to changes in staffing levels, the structure of employment in the space industry, and difficulties in recruiting personnel and business planning. The benefits provided to companies by trained space technologist are discussed. The jobs created by the use of space products in communications, TV, and microgravity are described. I.F.

A87-39899#
THE ALTERNATIVE TO 'LAUNCH ON HUNCH'
ERIC J. LERNER Aerospace America (ISSN 0740-722X), vol. 25, May 1987, p. 40, 41, 44.

An evaluation is made of the operational consequences of a change in NASA launch decision-making policy from the nonquantitative Failure Modes and Effects Analysis (FMEA) method to the nuclear industry's fully quantitative Probability Risk Assessment (PRA). In FMEA, each component or subcomponent is analyzed and the ways it can fail are determined with a view to their effect on subsystems, systems, and entire vehicles. In PRA, a possible failure mode for the entire system is identified, and the possible ways in which this may occur are listed with a view to contributory faults and chains of faults whose analyses ultimately arrive at a basis in some component failure or human error. O.C.

A87-41571* National Aeronautics and Space Administration, Washington, D.C.
THE SPACE STATION OVERVIEW
JOHN D. HODGE and WILLIAM P. RANEY (NASA, Office of Space Station, Washington, DC) (IAF, International Astronautical Congress on Space: New Opportunities for all People, 37th, Innsbruck, Austria, Oct. 4-11, 1986) Acta Astronautica (ISSN 0094-5765), vol. 16, 1987, p. 55-62.

This paper is an overview of the Space Station status and activities being undertaken by NASA in cooperation with Canada, the European Space Agency and Japan. A review of the progress within the past year including user requirements, design baseline, operations concept and program planning is covered. Discussion of design decisions and recent changes in the management organization are highlighted. Of special importance is discussion of the Space Station utilization with focus on insuring that the design requirements are responsive to user needs and consistent with life cycle cost. A preliminary operations concept is explored, and options for evolving the Space Station identified. Author

A87-46332* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
MAN'S ROLE IN SPACE EXPLORATION AND EXPLOITATION
JOSEPH P. LOFTUS (NASA, Johnson Space Center, Houston, TX) Spaceflight (ISSN 0038-6340), vol. 29, June 1987, p. 240-247.

The crew workloads on the Space Shuttle are described. The Space Shuttle is designed to minimize the activity of the crew in maintaining and operating the Shuttle in order for the crew to be involved in productive activities. The changing role of the crew due to the use of more automated systems on spacecraft is examined. The Shuttle flight system is dependent on embedded software, and the crew is to manage and support these systems. The primary functions of the Space Station are as a laboratory and for construction and assembly of systems, requiring EVA. Examples of EVA are presented. The correlation between manned and unmanned systems and the future direction of space research are discussed. I.F.

A87-49647* American Inst. of Aeronautics and Astronautics, New York, N.Y.
STRATEGIES FOR REVITALIZING ORGANIZATIONS; PROCEEDINGS OF THE SECOND NASA SYMPOSIUM ON QUALITY AND PRODUCTIVITY, WASHINGTON, DC, DEC. 2, 3, 1986
MIREILLE GERARD, ED. and PAMELA W. EDWARDS, ED. (AIAA, New York) Symposium sponsored by NASA,. New York, American Institute of Aeronautics and Astronautics, 1987, 275 p. No individual items are abstracted in this volume.
(Contract NASW-4096)

Attention is given to topics concerning managerial improvement of the American economy's goods and services through enhanced workforce productivity. The broad topic of entrepreneurialism in management organizations was addressed with a view to its effect on innovation in large corporations, and methods for measuring and sharing productivity increases were treated with respect to white collar productivity. Also discussed are participative management techniques and their implementation, and worker involvement in the enhancement of product quality. O.C.

A87-53073#
A SOLUTION TO THE MISSION PLANNING PROBLEM
RICHARD BROWN (Mitre Corp., Bedford, MA) IN: AAAIC '86 - Aerospace Applications of Artificial Intelligence; Proceedings of the Second Annual Conference, Dayton, OH, Oct. 14-17, 1986. Volume 1 . Dayton, OH, AAAIC Conference Secretariat, 1986, p. 192-199.

Mission planning is a special instance of the general planning problem in that a complete list of tasks and subtasks can be enumerated from the initial problem specification. Mission planning emphasizes resource allocation and scheduling, rather than discovering the sequence of steps that accomplish some goal. A 'solution' to the problem is a formalism (and a set of inference mechanisms) in which all relevant facts can be declaratively represented. These 'facts' include definitions of application-specific terms and relations, correctness and desirability criteria, and problem-solving strategies. This paper presents such a solution. Author

A87-53990
THE PRIVATE SOLUTION TO THE SPACE TRANSPORTATION CRISIS
JAMES BENETT (American Rocket Co., Camarillo, CA) and PHILLIP SALIN (Venture Acceleration, Redwood City, CA) Space Policy (ISSN 0265-9646), vol. 3, Aug. 1987, p. 181-205. refs

The history of STS development by NASA and the current status of NASA programs are examined critically from a private-sector perspective, and recommendations for further privatization of STS operations are presented. Numerical data documenting the evolution of aircraft (from 1919 to 1982) and of launch vehicles (from 1957 to the present) are compiled in tables and graphs, and the limited, basic R&D activities of NACA are contrasted with NASA's efforts to develop, own, and operate STSs. It is argued that the primary goal of an STS program should be to lower the cost of access to space, that NASA has failed to attain this goal, and that competing private companies, forced to meet customer demands rather than political standards, would be more likely to succeed. The original decision to concentrate funding on one large and highly complex STS (the Space Shuttle) is criticized, and specific political strategies to achieve almost complete privatization of the STS program are proposed. T.K.

N87-11486# Technische Hogeschool, Delft (Netherlands). Dept. of Mathematics and Informatics.
ON ACTIONS DUE TO LACK OF INFORMATION
B. G. LUNDBERG 1985 19 p
(REPT-85-45; ETN-86-98475) Avail: NTIS HC A02/MF A01

The problem of making conclusions from representations of knowledge is analyzed. Conclusion-making due to lack of information is studied. The concepts of immediately available information, assumptionally inferable information, and constructively inferable information are introduced. It is shown that it is important

to specify the assumptions that are made about a representation, in particular with respect to the conclusions that can be made from the representation. For constructively inferable information, it is shown that the lack of information can only be used to select which among a set of possible conclusions to make. ESA

N87-15898# National Academy of Public Administration, Washington, D. C.
NASA: THE VISION AND THE REALITY
ERASMUS H. KLOMAN Oct. 1985 66 p
(OP-5) Avail: NTIS HC A04/MF A01

The complex of aspirations and national priorities lying behind the original vision of the civilian space program and how that program has fared in the real world of politics centering on Washington were explored. The programmatic evolution of NASA and some of the key administrative and management concepts developed to govern the operation of the agency were examined. In gathering information, both former and present NASA officials were interviewed as well as knowledgable individuals outside the agency. B.G.

N87-16649# Rolls-Royce Ltd., Derby (England).
THE ROLE OF DESIGN IN THE MANAGEMENT OF TECHNOLOGY
J. F. COPLIN 5 Aug. 1986 53 p
(PNR90329; ETN-87-98776) Avail: NTIS HC A04/MF A01

The process of design and the tools used to maximize the value of advanced technology are reviewed. ESA

N87-16650# Texas Univ., Austin. Graduate School of Business.
A STUDY OF ORGANIZATIONAL INFORMATION SEARCH, ACQUISITION, STORAGE AND RETRIEVAL Final Report, Nov. 1983 - May 1986
GEORGE P. HUBER Aug. 1986 290 p
(Contract MDA903-83-C-0440; DA PROJ. 2Q1-61102-B-74-F)
(AD-A172063; ARI-RN-86-88) Avail: NTIS HC A13/MF A01
CSCL 05A

The purpose of the study reported was to determine what is known and is not known about these organizational processes so that potential researchers and research resource providers might be wiser in their choice of research topics to study. Contents: Information Environments; How Organizations Learn: A Communication Framework; The Decision Making Paradigm of Organizational Design; Exploiting Information Technologies to Design More Effective Organizations; The Systems Paradigm in the Development of Organization Theory: Correcting the Record and Suggesting the Future; and Organizational Design: Proposed Theoretical and Empirical Research are presented. GRA

N87-17527# Army Engineer School, Fort Belvoir, Va. Inst. for Water Resources.
COLLABORATIVE PROBLEM SOLVING FOR INSTALLATION PLANNING AND DECISION MAKING
C. M. DUNNING Sep. 1986 90 p
(AD-A174611; IWR-86-R-6) Avail: NTIS HC A05/MF A01
CSCL 05A

This manual introduces collaborative problem solving (CPS) as a method of accomplishing installation planning tasks. CPS is a process in which those with a stake in the outcome of a decision participate in a search for solutions which all can support. The manual describes the general principles involved in CPS, and presents the steps involved in designing and conducting the CPS meetings at installations. GRA

N87-17801*# Los Alamos National Lab., N. Mex.
INTERMARS: USER-CONTROLLED INTERNATIONAL MANAGEMENT SYSTEM
HARRISON H. SCHMITT *In* NASA. Marshall Space Flight Center Manned Mars Mission. Working Group Papers, V. 2, Sect. 5, App. p 951-960 May 1986
Avail: NTIS HC A24/MF A01 CSCL 05D

Existing international space law as well as the best interest of all nations are consistent with the establishment of a user-based international organization, herein called INTERMARS. INTERMARS would provide access to facilities and services at a Martian base which would be of high functional potential, quality, safety, and reliability. These opportunities would be available on an open and nondiscriminatory basis to all peaceful users and investors. INTERMARS is a model organization concept tailored to provide cooperative international management of a Martian base for the benefit of its members, users, and investors. Most importantly, INTERMARS would provide such management through a sharing of both sovereignty and opportunity rather then unilateral control by any one nation or set of competing nations. Through an Assembly of Parties, a Board of Governors, a Board of Users and Investors, and a Director General, INTERMARS would meet its primary goal as it would be in the self-interest of all members, users, and investors to do so. The internal structure and philosophy of INTERMARS would provide not only for all participants to have representation in decisions affecting its activities, but also would insure effective and responsive management. Surely this is the precedent wished for, to establish for mankind at the now not-so-distant shores of the new ocean of space. Author

N87-20128# Massachusetts Inst. of Tech., Cambridge. Man-Machine Systems Lab.
SATISFICING DECISION-MAKING IN SUPERVISORY CONTROL, PART 2 Final Report, Mar. 1983 - Jul. 1986
LEONID CHARNY and THOMAS B. SHERIDAN 31 Jul. 1986 59 p
(Contract N00014-83-K-0193)
(AD-A174631) Avail: NTIS HC A04/MF A01 CSCL 05A

This paper describes a flexible graphics system GraMAD for aiding a human decision-maker in making a selection out of a discrete set of alternatives while trading off several criteria. Three major components of this selection process, called satisficing, are identified and three modes of information presentation to the decision-maker are studied. Necessary elements of multiple-objective computer aiding systems are discussed. Results of experiments with human subjects working with the GraMAD system are discussed. GRA

N87-20130# Los Alamos National Lab., N. Mex.
FOUNDATIONS OF DECISION ANALYSIS: A SIMPLIFIED EXPOSITION
W. J. WHITTY Nov. 1986 24 p
(Contract W-7405-ENG-36)
(DE87-002236; LA-10702-MS) Avail: NTIS HC A02/MF A01

An evaluation requires the specification of criteria that are critical to the achievement of the objective and representative of the system under evaluation. These criteria are expressed numerically as performance measures. The latter usually have dissimilar units, and a problem arises in finding a means of relating them to a common unit of measure. Once related to a common unit, they can be aggregated to produce a single scalar of overall system worth. A simplified exposition of decision analysis is presented, which is a structured approach for evaluating complex alternatives providing an overall measure of system worth. Evaluations are discussed under situations where the evaluator knows for certain what the outcome will be for any course of action taken and for cases where the outcome is uncertain but can be estimated. Decision making under certainty is covered first, including the concepts of total value, value functions, weights, and group decisions. Then, decision making under uncertainty is discussed. Included are the parallel topics of total expected utility, utility functions, scaling constants, and group decisions. Extensions of

the procedures described, including fuzzy set theory and optimization methods, are discussed briefly. DOE

N87-20340*# Bionetics Corp., Hampton, Va.
AN ADVANCED TECHNOLOGY SPACE STATION FOR THE YEAR 2025, STUDY AND CONCEPTS Contractor Report, May-Nov. 1986
M. J. QUEIJO, A. J. BUTTERFIELD, W. F. CUDDIHY, C. B. KING, and P. A. GARN Mar. 1987 191 p
(Contract NAS1-18267)
(NASA-CR-178208; NAS 1.26:178208) Avail: NTIS HC A09/MF A01 CSCL 22B

A survey was made of potential space station missions that might exist in the 2020 to 2030 time period. Also, a brief study of the current state-of-the-art of the major subsystems was undertaken, and trends in technologies that could impact the subsystems were reviewed. The results of the survey and study were then used to arrive at a conceptual design of a space station for the year 2025. Factors addressed in the conceptual design included requirements for artificial gravity, synergies between subsystems, and the use of robotics. Suggestions are made relative to more in-depth studies concerning the conceptual design and alternative configurations. Author

N87-20834*# Houston Univ., Tex. Dept. of Industrial Engineering.
AN INVESTIGATION OF TRANSITIONAL MANAGEMENT PROBLEMS FOR THE NSTS Annual Report
JOHN L. HUNSUCKER and JAPHET S. LAW 15 Jan. 1987 405 p
(Contract NAS9-17315)
(NASA-CR-171979; NAS 1.26:171979) Avail: NTIS HC A18/MF A01 CSCL 05A

Analysis and recommendations were provided to the National Space Transportation System (NSTS) on managing the transition from a research and development (R/D) structure to an operational structure. Summaries of published literature on the theory and applications of transition, or change management, and the results of interviews with additional industry personnel whose organizations either have gone through or are now going through change are contained. The issues of flight rates and the flight decision are addressed. The use of a computer simulation model to analyze the effect of varying different parameters on the flight rate was also discussed. The issue of NASA's changing demographics was examined and why this may be a cause for concern. The impact of the whole shuttle system structure on the Challenger accident was presented along with the highlights of the Rogers Commission Report. The proposed reorganization of the NSTS management structure is discussed and how this transition from R/D to operations can be performed. B.G.

N87-24381*# National Academy of Sciences - National Research Council, Washington, D. C. Space Science Board.
STRATEGY FOR EXPLORATION OF THE OUTER PLANETS: 1986-1996 Interim Report
Dec. 1986 110 p Sponsored by NASA, Washington
(NASA-CR-181021; NAS 1.26:181021; PB87-158556) Avail: NTIS HC A06/MF A01 CSCL 03B

Over the past decade COMPLEX has published three strategy reports which, taken together, encompass the entire planetary system and recommend a coherent program of planetary exploration. The highest priority for outer planet exploration during the next decade is intensive study of Saturn (the planet, satellites, rings, and magnetosphere) as a system. The Committee additionally recommends that NASA engage in the following supporting activities: increased support of laboratory and theoretical studies; pursuit of earth-based and earth-orbital observations; commitment to continued operation of productive spacecraft; implementation of the instrument development plan as appropriate for the outer solar system; studies of deep atmospheric probes; development of penetrators or other hard landers; development of radiation-hardened spacecraft; and development of low-thrust propulsion systems. Longer-term objectives include exploration and intensive study of: the Uranus and Neptune systems; planetology of the Galilean satellites and Titan; and the inner Jovian system. GRA

N87-25872# General Accounting Office, Washington, D. C. General Government Div.
SMALL BUSINESS ACT: NASA'S (NATIONAL AERONAUTICS AND SPACE ADMINISTRATION'S) DISADVANTAGED BUSINESS ADVOCATE NOT REPORTING TO PROPER MANAGEMENT LEVEL
Apr. 1987 9 p
(PB87-176798; GAO/GGD-87-50; B-222903.12) Avail: NTIS HC A02/MF A01 CSCL 05A

The report reviews 13 agencies to determine their compliance with Section 15(k) of the Small Business Act. In subsequent discussions, the Chairman's office defined the primary concern as the agency's compliance with Section 15(k)(3), which described the required reporting level for each agency's director, Office of Small and Disadvantaged Business Utilization (OSDBU). The National Aeronautics and Space Administration (NASA) was one of the agencies selected. GRA

N87-29371# Virginia Polytechnic Inst. and State Univ., Blacksburg. Management Systems Labs.
RESEARCH AND DEVELOPMENT OF MODELS AND INSTRUMENTS TO DEFINE, MEASURE, AND IMPROVE SHARED INFORMATION PROCESSING WITHIN GOVERNMENT OVERSIGHT AGENCIES Annual Performance Report, Aug. 1986 - Feb. 1987
H. A. KURSTEDT, JR. 1987 45 p
(Contract DE-FG05-86DP-70033)
(DE87-012473; DOE/DP-70033/1) Avail: NTIS HC A03/MF A01

The tangible result of the research effort will be an integrated set of descriptive, prescriptive, predicative, performance, and responsive tools that will collectively allow government oversight agencies (GOAs) to increase their performance to the highest levels possible. GOAs will see increases in productivity, fewer conflicts between headquarters and the field, greater motivation on the part of personnel who actively share in the process of decision making, and greater credibility with Congress, the public, and the media. This results from the consistency and integrity of data and information - and the correct perception of government running a tight ship. DOE

N87-30248*# National Aeronautics and Space Administration, Washington, D.C.
LEADERSHIP AND AMERICA'S FUTURE IN SPACE
SALLY K. RIDE Aug. 1987 64 p
(NASA-TM-89638; NAS 1.15:89638) Avail: NTIS HC A04/MF A01 CSCL 05D

In response to growing concern over the posture and long-term direction of the U.S. civilian space program, a task group was formed to define potential U.S. space initiatives, and to evaluate them in light of the current space program and the nation's desire to regain and retain space leadership. The objectives were to energize a discussion of the long-term goals of the civilian space program and to begin to investigate overall strategies to direct that program to a position of leadership. Four initiatives were identified: mission to planet Earth; exploration of the solar system; outpost on the Moon, and humans to Mars. All four initiatives were developed in detail, and the implications and requirements of each was assessed. The long-term goals, current posturing required to attain these goals, and the need for a continuing process to define, refine, and assess both the goals and the strategy to achieve them are discussed. B.G.

03

INDUSTRIAL MANAGEMENT AND MANUFACTURING

Includes Industrial Management, Engineering Management, Design Engineering, Production Management, Construction, Aerospace/Aircraft Industries, Manufacturing.

A87-10091
SPACE SHUTTLE: A TRIUMPH IN MANUFACTURING
R. L. VAUGHN, ED. (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) Dearborn, MI, Society of Manufacturing Engineers, 1985, 265 p. No individual items are abstracted in this volume.

The manufacturing techniques employed in the construction of the STS and various Shuttle payload components and some manufacturing implications of experiments performed on Shuttle missions are discussed in a collection of previously published reviews and reports. The major topics covered are materials, design and assembly, tooling, and manufacturing systems. Consideration is given to the early development of the Shuttle tiles, high-temperature reusable surface insulaiation, materials processing in space, thermoplastic composite materials, metal-matrix composites, Be applications, the lightweight tanks, drilling of superalloy parts, welding of the crew module, big tools for deep space, robotics used by NASA in building the Shuttle, and preliminary materials tests for the Space Station. Drawings, diagrams, graphs, and extensive photographs are provided. T.K.

A87-11349
MANUFACTURING IN SPACE: PROCESSING PROBLEMS AND ADVANCES
V. S. AVDUEVSKII, S. D. GRISHIN, L. V. LESKOV, V. V. SAVICHEV, and V. T. KHRIAPOV (Tekhnicheskie i Tekhnologicheskie Problemy Kosmicheskogo Proizvodstva, Moscow, Izdatel'stvo Mir, 1985) Moscow, Mir Publishers, 1985, 248 p. Translation. refs

A systematic analysis of the experimental studies into space manufacturing conducted in the USSR is presented. Technological experiments, and space systems and equipment for space manufacturing are discussed. Experimental studies related to the preparation of electronic materials, space metallurgy, glass manufacturing, and space biotechnology are described. Experiments designed to analyze the effects of weightlessness on the physical features of processes are examined. The transportation and power generating system for space manufacturing is considered. I.F.

A87-13002#
THE INFLUENCE OF AEROSPACE DEVELOPMENTS UPON DEVELOPMENTS IN MANUFACTURING
R. S. DAVIE, L. M. GILLIN, and J. K. RUSSELL (Swinburne Institute of Technology, Hawthorn, Australia) IN: Joint National Symposium on the Influence of Aviation on Engineering and the Future of Aeronautics in Australia, Melbourne, Australia, August 8, 9, 1985, Preprints . Barton, Australia/Brookfield, VT, Institution of Engineers/Brookfield Publishing Co., 1985, p. 1-4.

An interpretive development history is presented for the ways in which growing demands for higher precision and extreme fabrication process condition resistances in the processes and materials of the aerospace industry have served as drivers in manufacturing engineering generally. Aerospace design complexity has notably led to the intensive development of computer aided design and manufacturing technologies that have subsequently undergone very general application in other industries. O.C.

A87-13011#
STRUCTURAL DESIGN WITH NEW MATERIALS
B. C. HOSKIN (Department of Defence, Aeronautical Research Laboratories, Melbourne, Australia) IN: Joint National Symposium on the Influence of Aviation on Engineering and the Future of Aeronautics in Australia, Melbourne, Australia, August 8, 9, 1985, Preprints . Barton, Australia/Brookfield, VT, Institution of Engineers/Brookfield Publishing Co., 1985, p. 44-47. refs

Attention is given to the development status of the advanced structural design methods which complement state-of-the-art lightweight materials' use in aircraft primary structures. The ways in which the introduction of fiber-reinforced polymer matrix composites has affected airframe structure design and analysis procedures are characterized. Attention is given to single-ply mechanics, symmetric, orthotropic and quasi-orthotropic laminate properties, the laminate stress-strain law, and such in-service composite structure factors as environmental effects, near-invisible impact damage, and fatigue. O.C.

A87-17143*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
HOW DIFFERENT A MODERN SST WOULD BE
C. DRIVER (NASA, Langley Research Center, Hampton, VA) Aerospace America (ISSN 0740-722X), vol. 24, Nov. 1986, p. 26-29.

The characteristics of a proposed SST are described. The proposed aircraft is to have two engines and an arrow-wing design, a passenger capacity of 250, and attain speeds of Mach 2.7. The low fineness ratio, low-aspect ratio wing planform, different engine nacelles location, and improved lift-to-drag ratio of the aircraft contribute to attaining an economical supersonic cruise. The proposed structural design and materials for the aircraft are examined; the material and design are to be applicable to high Mach and high temperature. Changes in the SST propulsion system, the nozzle designs, and landing and takeoff procedures to improve the operation of the aircraft are discussed. I.F.

A87-17283
MATERIALS FOR AEROSPACE
M. A. STEINBERG (California, University, Los Angeles) Scientific American (ISSN 0036-8733), vol. 255, Oct. 1986, p. 67-72.

Advances in both materials and fabrication processes are noted to play a key role in prospective high-performance-aircraft and spacecraft development. An evaluation is presented for primary airframe structure composites and alloys, ceramic- and glass-matrix composites for propulsion systems, and carbon/carbon refractory composites for elevated temperature applications. Major processing advances discussed encompass centrifugal and inert gas atomization of alloy powders, hot extrusion, and dynamic compaction. Attention is given to the unique materials called for in the structure of the projected NASA hypersonic/transatmospheric vehicle. O.C.

A87-17888#
INNOVATIONS IN AIRCRAFT SYSTEMS MANAGEMENT TO MEET 1990-2000 REQUIREMENTS
S. N. MULLIN (Lockheed-California Co., Burbank) AIAA, AHS, and ASEE, Aircraft Systems, Design and Technology Meeting, Dayton, OH, Oct. 20-22, 1986. 8 p. refs
(AIAA PAPER 86-2629)

A87-17889#
X-29 - MANAGING AN INTEGRATED ADVANCED TECHNOLOGY DESIGN
G. L. SPACHT (Grumman Corp., Bethpage, NY) AIAA, AHS, and ASEE, Aircraft Systems, Design and Technology Meeting, Dayton, OH, Oct. 20-22, 1986. 6 p.
(AIAA PAPER 86-2630)

The X-29 is the fulfillment of a program initiated in 1976 to explore the aerodynamic advantages of the forward swept wing. The aircraft, however, is much more than a forward swept wing demonstrator. The X-29 is an integrated advanced technology demonstrator incorporating eight advanced technologies in a single

aircraft. The integrated aspect of the program cannot be over-emphasized because integration can be considered an additional technology that, if not successfully managed, could have endangered the entire program. The goal of the X-29 flight test program is to successfully demonstrate the performance of the integrated technology set in flight. This paper explains the philosophy of the technologies incorporated in the X-29 aircraft, the steps taken to reduce the risk of the inherently high risk program, and the benefits of the management approach as demonstrated by the flight test program. Author

A87-17914*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE EFFECT OF ADVANCED TECHNOLOGY ON THE SECOND-GENERATION SST
P. G. COEN (NASA, Langley Research Center, Hampton, VA) AIAA, AHS, and ASEE, Aircraft Systems, Design and Technology Meeting, Dayton, OH, Oct. 20-22, 1986. 5 p.
(AIAA PAPER 86-2672)

Technological developments that promise to substantially increase the efficiency of next-generation subsonic commercial aircraft, together with additional developments in supersonic aircraft aerodynamics, structures and propulsion systems, are presently evaluated in order to project the extent of performance and economic improvement obtainable for a future SST by comparison to the Concorde SST. It is demonstrated that the second-generation SST projected will double passenger-carrying capacity from 100 for the Concorde to 200, despite reducing takeoff gross weight from 400,000 to 321,000 lbs and extending range by some 2000 nm. O.C.

A87-18898
SYSTEMS ENGINEERING - A PROPOSED DEFINITION
P. K. MPHERSON (City University, London, England) (IEE, Colloquium on Systems Engineering: Its Nature and Scope, London, England, Nov. 13, 1985) IEE Proceedings, Part A Physical Science, Measurement and Instrumentation, Management and Education, Reviews (ISSN 0143-702X), vol. 133, pt. A, no. 6, Sept. 1986, p. 330, 331.

A definition of 'systems engineering' is proposed, to stimulate further discussion directed towards a concensus view. It is a hybrid methodology comprising three modes: policy analysis, design, and management. Thus it is a matrix of methodologies drawing on the procedures provided by people working in a wide range of functions, which are integrated to constitute a total system. Systems engineering is different from classical engineering. It is the product and the price of that technological progress that leads to ever more complex man-made systems. It breaks through the 'complexity threshold' to ensure that major enterprises are properly conceived and successfully brought into being. Author

A87-18899
MANAGING SYSTEM CREATION
D. K. HITCHINS (Racal Defence Systems, Ltd., Fleet, England) IEE Proceedings, Part A - Physical Science, Measurement and Instrumentation, Management and Education, Reviews (ISSN 0143-702X), vol. 133, pt. A, no. 6, Sept. 1986, p. 343-354.

The life cycle of an information/decision/action system (IDAS) for engineering management is characterized, emphasizing the fact that an IDAS includes not only individuals, companies, government agencies, and computer-based data systems but also the systems engineers attempting to introduce the IDAS. IDAS design approaches and a number of concrete examples are illustrated with block diagrams and flow charts. Consideration is given to project team structure, system tasks and skills, functional decomposition, design drivers and tradeoffs, architectures and interfaces, and test integration and simulation. T.K.

A87-19604
RELIABILITY AND MAINTAINABILITY MANAGEMENT
B. S. DHILLON (Ottawa, University, Canada) and H. REICHE New York, Van Nostrand Reinhold Co., 1985, 255 p. refs

The management of engineering projects to meet reliability and maintainability (R&M) goals is described in an introductory textbook. Topics examined include R&M mathematics, the basic principles and measures of R&M, fundamentals of management, engineering manpower characteristics, life-cycle management of a system, management of R&M documents, R&M management tools, R&M manpower and data requirements, R&M design-review processes, and life-cycle costing and warranties. Graphs, diagrams, and exercises are provided. T.K.

A87-24649
ENGINEERING CHANGES FOR MADE-TO-ORDER PRODUCTS - HOW AN MRP II SYSTEM SHOULD HANDLE THEM
G. HARHALAKIS (Maryland, University, College Park) Engineering Management International (ISSN 0167-5419), vol. 4, Oct. 1986, p. 19-36.

Engineering or design changes are an integral part of any design and manufacturing chain of activities. In a made-to-order environment, standard design changes are outnumbered by those emerging during the design and manufacturing stages of individual contracts. This paper discusses the peculiarities of engineering changes in such an environment and proposes an integrated approach to monitoring, controlling and reporting related activities, using a combination of MRP II modules, enhanced with manual forms, aimed at minimizing the painful impact of numerous design updates throughout the in-house product life cycle. Author

A87-26676
MANUFACTURING APPLICATIONS OF LASERS; PROCEEDINGS OF THE MEETING, LOS ANGELES, CA, JAN. 23, 24, 1986
PETER K. CHEO, ED. (United Technologies Research Center, East Hartford, CT) Meeting sponsored by SPIE. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings. Volume 621), 1986, 148 p. For individual items see A87-26677 to A87-26679.
(SPIE-621)

The present conference encompasses topics in laser material processing for industrial applications, laser applications in microelectronics, laser inspection and quality control, and laser diagnostics and measurements. Attention is given to the laser welding of cylinders, production laser hardfacing of jet engine turbine blades, production laser welding of gears, electric arc augmentation for laser cutting of mild steel, laser-assisted etching for microelectronics, and laser fabrication of interconnect structures on CMOS gate arrays. Also discussed are angle-scanning laser interferometry for film thickness measurements, the application of heterodyne interferometry to disk drive technology, and CARS applications to combustion diagnostics. O.C.

A87-29596#
MARKET SUPREMACY THROUGH ENGINEERING AUTOMATION
A. R. MITCHELL (Boeing Aerospace Co., Seattle, WA) Aerospace America (ISSN 0740-722X), vol. 25, Jan. 1987, p. 24-27.

State of the art industrial CAD/CAE practices used to explore design concepts, evaluate aerodynamic performance/configuration tradeoffs and numerically control tooling of a model are described. Minicomputer engineering workstations, soon to have access to mini-supercomputers and supercomputers, functioning on a LAN allow small engineering teams to generate, evaluate and define models within days instead of months. The specifications obtained are used to generate numerical code for shaping a model for the wind tunnel tests. Implementation of the capabilities at Boeing is described, with emphasis on software developed to permit tradeoff studies of rocket-ramjet and solid fueled missile and railgun concepts. A need is noted for management to combine diverse engineering personnel assets to optimize use of the engineering workstation network. M.S.K.

A87-31615#
JAPAN ADVANCES ITS AEROSPACE TIMETABLE
NEIL W. DAVIS Aerospace America (ISSN 0740-722X), vol. 25, March 1987, p. 18-22.

Economic pressures caused by the recent unprofitability of industries such as shipbuilding are encouraging large Japanese companies to accelerate the development of aerospace products. For example, Mitsubishi is increasing the information links between factories, including the Nagoya Aircraft Works which is to build the H-II launch vehicle. A common pattern is that Japanese manufacturers lease technologies from U.S. companies to build, e.g., missiles and aircraft, assimilate the technologies, improve on them, and then end the cooperative relationships. Cooperation also allows participation in large programs which Japan can not do alone, such as the Space Station and the 7J7 aircraft. An in-depth survey is provided of the involvements of specific Japanese companies in launch vehicle, satellite, semiconductor, supercomputer, aircraft and telecommunications programs.
M.S.K.

A87-32205
MANUFACTURING OF HIGH QUALITY COMPOSITE COMPONENTS IN AEROSPACE INDUSTRY
ASHOK K. MUNJAL (Aerojet Strategic Propulsion Co., Sacramento, CA) Society of Manufacturing Engineers, Conference on Composites in Manufacturing, 5th, Los Angeles, CA, Jan. 13-16, 1986, Paper. 20 p. refs

The defects to which composite materials are subject are discussed in terms of the available NDT techniques for detecting their presence. Composites differ from other structural materials in that the chemistry of the materials, from the start of manufacturing process to the finished product, is as significant as the final mechanical and environmental properties. Attention is given to the capabilities of chromatographic, spectrographic, NMR, IR, gravimetric, thermomechanical, and calorimetric methods for evaluating resin properties. Radiographic, thermographic, ultrasonic, etc., techniques for detecting defects in finished products are summarized. The criticality of 20 types of known defects are explored with reference to their use as aircraft components, along with the manufacturing conditions which cause the defect to occur.
M.S.K.

A87-32653
AN INTRODUCTION TO FLIGHT SIMULATION FOR THE AERODYNAMIC ENGINEER
THOMAS M. SPURA (Singer Co., Link Div., Binghamton, NY) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 13 p.
(SAE PAPER 861815)

The manufacturing requirements for producing flight training simulators are described to serve as a guide to the courses of study for aeronautical engineers who wish to develop simulators. A general description is given of standard simulator cockpits, scene generation capabilities, controls and control responses, and the computer systems necessary to drive simulations. The economic desirability of using simulators for flight training is discussed in terms of the diversity of flight conditions which can be safely presented with no costs of actual flights being accrued. The regulations governing the capabilities of simulators for flight training are reviewed, along with nominal procedures which are followed in the design, manufacture and programming of a simulator.
M.S.K.

A87-33152* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TRANSITION TO SPACE - A HISTORY OF 'SPACE PLANE' CONCEPTS AT LANGLEY AERONAUTICAL LABORATORY 1952-1957
JAMES R. HANSEN (NASA, Langley Resarch Center, Hampton, VA) British Interplanetary Society, Journal (Pioneering Space) (ISSN 0007-084X), vol. 40, Feb. 1987, p. 67-80. refs

The supersonic speeds of X-series aircraft and wind tunnel data in the early 1950s demonstrated that hypersonic flight was an achievable goal. A blunt-nosed vehicle was found to form a bow shock that deflected much of the heating an aircraft would otherwise experience at high speeds. It was felt that critical aspects of hypersonic flight, e.g., aerodynamic performance and heating, controllability, etc., could not be fully explored in wind tunnels. The X-15 project was initiated by NASA in 1954 to produce a vehicle capable of Mach 7 flight to altitudes that would permit short evaluations of human performance in microgravity. Design tradeoffs examined in the program are discussed, with emphasis on lifting bodies and winged vehicles with high L/D ratios. Political pressures created by the public triumph of the Sputnik in 1958 removed much of the impetus for development of a manned spaceplane, and long-term goals that eventually led to the Shuttle were delayed by a short-term program oriented toward ballistic manned capsules.
M.S.K.

A87-33477
JAPAN'S HIGH TECHNOLOGY INDUSTRIES
HUGH PATRICK, ED. (Columbia University, New York) Seattle, WA/Tokyo, University of Washington Press/University of Tokyo Press, 1986, 293 p. No individual items are abstracted in this volume.

In this book, Japan's high technology industrial policy is analyzed, and its relevance for the United States is assessed. An overview is given of these policies, and a critical evaluation of the most significant related policy issues is presented. In-depth analyses of the policies' effects on specific Japanese high technology industries are given, differences between economic conditions in the U.S. and Japan are studied, and Japanese and American policies on joint research and antitrust are compared.
C.D.

A87-33497
MANUFACTURING ENGINEERING: PRINCIPLES FOR OPTIMIZATION
DANIEL T. KOENIG (General Electric Co., Bridgeport, CT) Washington, DC, Hemisphere Publishing Corp., 1987, 359 p. refs

Various subjects in the area of manufacturing engineering are addressed. The topics considered include: manufacturing engineering organization concepts and management techniques, factory capacity and loading techniques, capital equipment programs, machine tool and equipment selection and implementation, producibility engineering, methods, planning and work management, and process control engineering in job shops. Also discussed are: maintenance engineering, numerical control of machine tools, fundamentals of computer-aided design/computer-aided manufacture, computer-aided process planning and data collection, group technology basis for plant layout, environmental control and safety, and the Integrated Productivity Improvement Program.
C.D.

A87-33558#
DESIGN ENGINEERING TECHNOLOGIES FOR AEROSPACE VEHICLES
ALAN R. MITCHELL, SAMUEL S. BRYAN, and MARK D. HALL (Boeing Aerospace Co., Seattle, WA) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 54-58.
(AIAA PAPER 87-0715)

The paper discusses engineering technologies which automate and integrate mechanical computer-aided design (MCAD) with computer-aided engineering (CAE) for aerospace vehicle development. It is found that MCAD configuration control becomes practical even in the earliest development phases because design variations and associated design analyses for trade studies can be rapidly performed. Initial development of this capability has emphasized the external geometry and associated aerodynamic predictions. Effort is made in progressing to include internal design definition and all the key CAE programs required in design analysis.
Author

A87-35283#
THE NEED FOR NEW TECHNOLOGIES FOR THE U.S. AEROSPACE INDUSTRY
ALAN M. LOVELACE (General Dynamics Corp., Saint Louis, MO) IN: Computerized aerospace materials data; Proceedings of the Workshop on Computerized Property Materials and Design Data for the Aerospace Industry, El Segundo, CA, June 23-25, 1986 . New York, American Institute of Aeronautics and Astronautics, Inc., 1987, p. 13-17.

Rapidly advancing technologies, materials technologies among them, have produced discontinuities in the progress of technologies, e.g., the overlap between the use of piston and jet engines. A new technology enters development with performance levels surpassing an old technology before the old technology is fully mature. Monitoring the advances is therefore a critical matter for competing organizations, particularly aerospace manufacturers who may witness transitions over a period of months. It is recommended that a computerized materials database be developed for the U.S. as a means for manufacturers to track national and worldwide advances in new materials and the means to produce and use them. M.S.K.

A87-35396* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE STATION - AN INNOVATIVE APPROACH TO MANUFACTURING DEVELOPMENT
KENNETH W. SULLIVAN and CHRISTOPHER J. BRAMON (NASA, Marshall Space Flight Center, Huntsville, AL) Aerospace Engineering (ISSN 0736-2536), vol. 7, March 1987, p. 26-31.

The development of the common modules for the planned dual-keel Space Station, which is a figure-eight configuration that requires the use of four common modules linked by six docking nodes in the center of the Station, is examined. The fabrication of the proposed common module designs, which are a four-barrel common module structure built using excess external tank barrel panels (Martin Marietta Michoud Aerospace), and a three-barrel design consisting of 2219 Al skins with a waffle-grid pattern machined on the outer surface (Boeing Aerospace Corporation) is described. The assistance provided by the NASA-Marshall Space Flight Center's Materials and Processes Laboratory, in particular the variable polarity plasma arc welding process, in the development of the common modules is discussed. I.F.

A87-35397
TOWARD THE FACTORY OF THE FUTURE
JAMES H. BRAHNEY Aerospace Engineering (ISSN 0736-2536), vol. 7, March 1987, p. 34-38.

The use of automation and computer technology to improve the manufacturing processes in the aerospace industry is examined. Research applying microelectronics, AI, and process science to the manufacturing of aerospace parts is discussed. The development and functions of a flexible machining system that is to improve quality and reduce costs are described. I.F.

A87-36288
AN INTEGRATED APPROACH TO ADVANCED CONCEPTUAL DESIGN
MICHAEL J. LOGAN (LTV Aerospace and Defense Co., Dallas, TX) SAWE, Annual Conference, 45th, Williamsburg, VA, May 12-14, 1986. 21 p.
(SAWE PAPER 1716)

Cost savings and technical accuracy are both enhanced by a new approach to conceptual design activities for advanced technology aircraft. A graphics-based workstation computer is used to integrate several conceptual design analysis programs into a single, stand-alone conceptual design system. The Vought multi-discipline Aircraft Synthesis Analysis Program (ASAP) is used as the primary design synthesis tool. Additional analyses available include survivability predictions, depending on the user's requirements. The second phase of the program will provide for the development of new configuration generation and analysis capability by incorporating expert system techniques. D.H.

A87-41679
THE IMPLEMENTATION AND CONTROL OF ADVANCED MANUFACTURING SYSTEMS
P. ANSTISS (British Aerospace, PLC, Preston, England) Aerospace Dynamics (ISSN 0263-2012), no. 21, 1987, p. 14-19.

An account is given of the development and control of a flexible manufacturing system for small machined parts which can prepare raw materials for fixturing, assemble all necessary resources, then process 'nests' of components through machining, inspection, and secondary operations to produce finished parts ready for surface treatment or painting. The system employs automated stores, transport and machine tools, local area network communications, advanced computer control systems for all automatic and manual functions, and comprehensive tool storage, handling and preparation facilities. O.C.

A87-49966#
COOPERATION KNOW-HOW IN HIGH-TECH PRODUCTS
HORST PREM (Messerschmitt-Boelkow-Blohm GmbH, Ottobrunn, West Germany) Binational Conference on Asia-Pacific Dimensions of International Business: A Joint French-German Approach, Universitaet Hohenheim, Stuttgart, West Germany, Oct. 16, 17, 1986, Paper. 26 p.
(MBB-Z-101-86-PUB)

European cooperation in the development of high-tech aircraft is discussed. The rationale for this cooperation is briefly reviewed, and the main technological targets of this cooperation are summarized. Examples of this cooperative development are examined, including helicopters, Airbus, combat aircraft, and possible hypersonic aircraft. C.D.

A87-53075#
APPLICATION OF ARTIFICIAL INTELLIGENCE (AI) TO AEROSPACE MANUFACTURING - A USER PERSPECTIVE
H. H. KING (McDonnell Aircraft Co., Saint Louis, MO) IN: AAAIC '86 - Aerospace Applications of Artificial Intelligence; Proceedings of the Second Annual Conference, Dayton, OH, Oct. 14-17, 1986. Volume 1 . Dayton, OH, AAAIC Conference Secretariat, 1986, p. 233-242. refs

An evaluation is made of the prospective performance improvements in aerospace manufacturing due to the application of AI expert systems. Functions for such systems are foreseen to encompass apprentice planners, which select cutting tools for metal working; buy-decision support systems, to determine what work should be subcontracted; expert machine selectors, which help in the selection and scheduling of numerically controlled machines; generative process planning systems, which will automate process planning functions associated with composites; and human factors analysis expert models, which will allow designers to graphically simulate labor requirements for manufacturing tasks. O.C.

N87-16380# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
THE USE OF THE FINITE ELEMENT METHOD
V. B. VENKAYYA *In* AGARD Practical Application of Finite Element Analysis to Aircraft Structural Design 39 p Aug. 1986
Avail: NTIS HC A07/MF A01

These lecture notes are primarily intended to provide a quick overview of the solid mechanics problem for engineers using a general purpose finite element system in the solution of aerospace structures problems. It gives a brief outline of the solid mechanics problem and some the available options for its solution. The finite element method is explained in more detail with particular emphasis on the use of membrane element in aerospace structural analysis. Author

N87-19347# Universal Energy Systems, Inc., Dayton, Ohio.
V/STOL CONCEPTS AND DEVELOPED AIRCRAFT. VOLUME 1: A HISTORICAL REPORT (1940-1986) Final Report, 3 Sep. 1978 - 26 Jun. 1986
BERNARD LINDENBAUM 26 Jun. 1986 455 p
(Contract F33615-83-C-3000)
(AD-A175379; AFWAL-TR-86-3071-VOL-1) Avail: NTIS HC A20/MF A01 CSCL 01C

A comprehensive, in-depth review of the development of VTOL and V/STOL concepts and aircraft other than the helicopter is presented. The time period covered is from the beginning of organized government-sponsored activity in the late 1940's through the present. Conventional helicopters are not discussed. Included are V/STOL aircraft which do use rotors but are aimed at providing cruise speeds and aerodynamic efficiencies similar to those of conventional airplanes. Although not aircraft in the conventional sense, wingless VTOL vehicles which use direct thrust (rocket or turbojet/turbofan) for lift in all flight modes also are included since such machines do have a close relationship to some of the more commonly accepted forms of VTOL aircraft. This volume contains an introductory review of V/STOL aircraft concepts and the rationale behind them. The concepts are categorized by propulsion system. This volume contains definitive information and technical reviews of the rocket belt, turbojet/turbofan platform type (wingless) vehicles, and turbojet/turbofan vertical attitude takeoff and landing aircraft. GRA

N87-20755*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A COMPUTER SIMULATOR FOR DEVELOPMENT OF ENGINEERING SYSTEM DESIGN METHODOLOGIES
S. L. PADULA and J. SOBIESZCZANSKI-SOBIESKI Feb. 1987 18 p
(NASA-TM-89109; NAS 1.15:89109) Avail: NTIS HC A02/MF A01 CSCL 12A

A computer program designed to simulate and improve engineering system design methodology is described. The simulator mimics the qualitative behavior and data couplings occurring among the subsystems of a complex engineering system. It eliminates the engineering analyses in the subsystems by replacing them with judiciously chosen analytical functions. With the cost of analysis eliminated, the simulator is used for experimentation with a large variety of candidate algorithms for multilevel design optimization to choose the best ones for the actual application. Thus, the simulator serves as a development tool for multilevel design optimization strategy. The simulator concept, implementation, and status are described and illustrated with examples. Author

N87-21128# Office of Technology Assessment, Washington, D.C.
NEW STRUCTURAL MATERIALS TECHNOLOGIES: OPPORTUNITIES FOR THE USE OF ADVANCED CERAMICS AND COMPOSITES
Sep. 1986 88 p
(PB87-118253; OTA-TM-E-32; LC-86-600551) Avail: NTIS HC A05/MF A01 CSCL 11B

New structural materials-ceramics, polymers, metals, or hybrid materials derived from these, called composites-open a promising avenue to renewed international competitiveness of U.S. manufacturing industries. There will be many opportunities for use of the materials in aerospace, automotive, industrial, medical, and construction applications in the next 25 years. GRA

N87-23985# Pacific Northwest Labs., Richland, Wash.
FEDERAL LABORATORY NONDESTRUCTIVE TESTING RESEARCH AND DEVELOPMENT APPLICABLE TO INDUSTRY
S. A. SMITH and N. L. MOORE Feb. 1987 259 p
(Contract DE-AC06-76RL-01830)
(DE87-008351; PNL-6143) Avail: NTIS HC A12/MF A01

This document presents the results of a survey of nondestructive testing (NDT) and related sensor technology research and development (R and D) at selected federal laboratories. The objective was to identify and characterize NDT activities that could be applied to improving energy efficiency and overall productivity in US manufacturing. Numerous federally supported R and D programs were identified in areas such as acoustic emissions, eddy current, radiography, computer tomography and ultrasonics. A Preliminary Findings Report was sent to industry representatives, which generated considerable interest. DOE

N87-25882# SES Development Corp., Arlington, Va.
GLOBAL COMPETITION AND TECHNOLOGY TRANSFER BY THE FEDERAL LABORATORIES: AN ASSESSMENT OF TECHNOLOGY TRANSFER MECHANISMS OF SELECTED NATIONAL LABORATORIES WITH A SPECIAL FOCUS ON SOLAR/RENEWABLE ENERGY TECHNOLOGIES, EXECUTIVE SUMMARY
R. E. ENGLER, JR. and P. G. VARGAS 20 Feb. 1987 131 p
(Contract DE-AC01-85CE-30848)
(DE87-008906; DOE/CE-30848/T1) Avail: NTIS HC A07/MF A01

The report is presented in five chapters. It begins with an overview of the general problem and an introduction to the special case of renewable energy. Then, in Chapter Two, a broad canvas is presented for considering technology transfer as technology development to solve priority social-technical problems faced by our society; and important historical features in America's past are presented along with speculation about their relevance to the present and future. Chapter Three describes the four selected national laboratories and their current efforts at enhancing technology transfer. Chapter Four pulls together key findings from the lab descriptions and other sources and presents them as continuing issues and guiding principles. Finally, in Chapter Five, recommendations are made to SERI, the Solar Energy Research Institute, for both the short range and long range. Long-range recommendations foresee a changed, more supportive climate and budget for solar/renewable energy and speculate about a far-reaching role for those technologies in a national effort at societal revitalization, redevelopment and renewal. DOE

N87-25990# Rand Graduate Inst. for Policies Study, Santa Monica, Calif.
NATIONAL AEROSPACE PLANE PROGRAM: PRINCIPAL ASSUMPTIONS, FINDINGS AND POLICY OPTIONS
SCOTT PACE Dec. 1986 24 p Presented at a course on the Uses of History in Public Policy, Santa Monica, Calif., Fall 1986
(RAND/P-7288-RGS) Avail: NTIS HC A02/MF A01

Top-level issues raised by the National Aerospace Plane Program (NASP) are examined. Its principle points are: major uncertainties in the rate of NASP technical progress, cost projections, and potential applications of NASP technology. NASP development costs and possible increases may force tradeoffs with other research and development efforts in subsonic aircraft and launch vehicle technology. The FY88-89 budget will require decisions on major funding increases for flying technology demonstrators. The high classification of some NASP technologies is limiting independent evaluation and may reduce commercial spinoffs. Major policy options that should be examined further are: maintain NASP research efforts, but deemphasize operational applications; hedge NASP research by expanding efforts in other space and aeronautical transport programs; and increase NASA responsibility for NASP work and ease classification restrictions. NASP is a promising technical effort that has made significant progress in the last year. The need for routine access to space and aeronautical leadership makes NASP a national priority. The costs and uncertainties of NASP, however, make it imperative to examine strategies for reducing its risks. Author

N87-26828 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Corporate Staff Dept.
STRATEGIC TECHNOLOGY ASSESSMENT: ONE ELEMENT IN HIGH TECH INDUSTRIAL DEVELOPMENT
HORST PREM and GEORGE W. STROKE *In its* Research and Development. Technical-Scientific Publications 1986 p 19-26 1986 Presented at the CESTA Conference, Marseille, France, 25-27 Feb. 1986
(MBB-Z-104/86) Avail: Issuing Activity

Strategies in technology assessment for industrial developments are discussed. Empirical strategies to achieve the necessary financial and innovative success under external influences or environmental conditions are presented. The evolution in the Japanese approach to product development is explained. A strategy for a multidimensional product-oriented technology assessment policy (definition, management, and implementation) is discussed. Technology assessment in Europe under the environmental extremes particular to the European Community is presented.
ESA

A87-13713
SPACE STATION AUTOMATION - THE ROLE OF ROBOTICS AND ARTIFICIAL INTELLIGENCE
W. T. PARK and O. FIRSCHEIN (SRI International, Menlo Park, CA) IN: Space station automation; Proceedings of the Meeting, Cambridge, MA, September 17, 18, 1985 . Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1985, p. 60-67.

Automation of the Space Station is necessary to make more effective use of the crew, to carry out repairs that are impractical or dangerous, and to monitor and control the many Space Station subsystems. Intelligent robotics and expert systems play a strong role in automation, and both disciplines are highly dependent on a common artificial intelligence (AI) technology base. The AI technology base provides the reasoning and planning capabilities needed in robotic tasks, such as perception of the environment and planning a path to a goal, and in expert systems tasks, such as control of subsystems and maintenance of equipment. Automation concepts for the Space Station are described, along with the specific robotic and expert systems and the R&D required to attain this automation. An evolutionary development plan is presented that leads to fully automatic mobile robots for servicing satellites. The sequence of demonstrations and the R&D needed to confirm the automation capabilities are summarized. It is emphasized that advanced robotics requires AI, and that to advance, AI needs the 'real-world' problems provided by robotics.
Author

04

ROBOTICS AND EXPERT SYSTEMS

Includes Artificial Intelligence, Robots and Robotics, Automatic Control and Cybernetics, Expert Systems, Automation Applications, Computer-Aided Design (CAD), Computer-Aided Manufacturing.

A87-12214#
RESEARCH NEEDS FOR AI IN MANUFACTURING
T. TRISCARI, JR. (USAF, Institute of Technology, Wright-Patterson AFB, OH) and W. M. HENGHOLD (Universal Technology Corp., Dayton, OH) IN: Annual Aerospace Applications of Artificial Intelligence Conference, 1st, Dayton, OH, September 16-19, 1985, Proceedings . Dayton, OH, AAAIC Secretariat, 1985, p. 115-126.

The Air Force Wright Aeronautical Laboratories' Material Laboratory is charged with developing a research program for applications of artificial intelligence (AI) as it relates to manufacturing. As a part of program development, advisory input was sought from experts from industry, academia, and government. A structured methodology was employed which featured a top-down approach leading from concept level articulation, through application area goals and objectives, to project level detail. This paper documents the effort in terms of providing methodological background, application area goals and objectives, and results obtained from project generation and assessment. Emphasis is on project level results.
Author

A87-13706* National Aeronautics and Space Administration, Washington, D.C.
THE ROLE OF AUTOMATION AND ROBOTICS IN SPACE STATIONS
D. C. BLACK (NASA, Office of Space Station, Washington, DC) IN: Space station automation; Proceedings of the Meeting, Cambridge, MA, September 17, 18, 1985 . Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1985, p. 2-9.

Automation and robotics have played important roles in space research, most notably in planetary exploration. While an increased need for automation and robotics in space research is anticipated, some of the major challenges and opportunities for automation and robotics will be provided by the Space Station. Examples of these challenges are briefly reviewed.
Author

A87-15810*# National Aeronautics and Space Administration, Washington, D.C.
THE EVOLUTION OF AUTOMATION AND ROBOTICS IN MANNED SPACEFLIGHT
T. L. MOSER (NASA, Washington, DC) and J. D. ERICKSON (NASA, Johnson Space Center, Houston, TX) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 20 p. refs
(IAF PAPER 86-12)

The evolution of automation on all manned spacecraft including the Space Shuttle is reviewed, and a concept for increasing automation and robotics from the current Shuttle Remote Manipulator System (RMS) to an autonomous system is presented. The requirements for robotic elements are identified for various functions on the Space Station, including extravehicular functions and functions within laboratory and habitation modules which expand man's capacity in space and allow selected teleoperation from the ground. The initial Space Station will employ a telerobot and necessary knowledge based systems as an advisory to the crew on monitoring, fault diagnosis, and short term planning and scheduling.
V.L.

A87-15812*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE USE OF COMPUTER GRAPHIC SIMULATION IN THE DEVELOPMENT OF ROBOTIC SYSTEMS
K. FERNANDEZ (NASA, Marshall Space Flight Center, Huntsville, AL) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 9 p. refs
(IAF PAPER 86-16)

This paper describes the use of computer graphic simulation techniques to resolve critical design and operational issues for robotic systems. Use of this technology will result in greatly improved systems and reduced development costs. The major design issues in developing effective robotic systems are discussed and the use of ROBOSIM, a NASA developed simulation tool, to address these issues is presented. Three representative simulation case studies are reviewed: off-line programming of the robotic welding development cell for the Space Shuttle Main Engine (SSME); the integration of a sensor to control the robot used for removing the Thermal Protection System (TPS) from the Solid Rocket Booster (SRB); and the development of a teleoperator/robot mechanism for the Orbital Maneuvering Vehicle (OMV).
Author

A87-15832*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NASA'S ROBOTIC SERVICING ROLE FOR SPACE STATION
L. POWELL, R. GOSS (NASA, Marshall Space Flight Center, Huntsville, AL), and R. SPENCER (Martin Marietta Corp., Denver, CO) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 8 p. refs
(IAF PAPER 86-47)

Attention is given to evaluations of the relative impacts on and benefits to the Space Station Program of various levels of robotics devices for space servicing operations. The leading robotic candidate concept for the IOC Space Station, the Smart Front End, uses a small, stiff and highly dexterous work effector controlled by a human-in-the-loop from a remote control station. This configuration offers both a quality multifunctional performance capability at the work site as well as technology transparency through the ground teleoperation control mode. K.K.

A87-15841*# National Aeronautics and Space Administration, Washington, D.C.
SPACE STATION AS A VITAL FOCUS FOR ADVANCING THE TECHNOLOGIES OF AUTOMATION AND ROBOTICS
G. VARSI and D. H. HERMAN (NASA, Washington, DC) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 7 p. refs
(IAF PAPER 86-62)

The application of robotics and automation technologies to the Space Station design is examined. Experiments being conducted in the fields of autonomy and robotics, and the benefits provided by these technologies are discussed. The use of automation and robotics in the operation management, the power system, and telerobot of the Space Station is described. I.F.

A87-16689
OPPORTUNISTIC SCHEDULING FOR ROBOTIC MACHINE TENDING
P. A. NEWMAN and K. G. KEMPF (McDonnell Douglas Research Laboratories, Saint Louis, MO) IN: The engineering of knowledge-based systems; Proceedings of the Second Conference on Artificial Intelligence Applications, Miami Beach, FL, December 11-13, 1985 . Washington, DC, IEEE Computer Society Press, 1985, p. 168-175. Research supported by the McDonnell Douglas Independent Research and Development Program. refs

An opportunistic knowledge-based scheduling system is described for arranging the work sequences performed in manufacturing a product in a manner that accommodates uncertain delivery dates for supplies. The system is illustrated in terms of a scheduler for a robot which tends various machine tools in a manufacturing cell. The robot informs the scheduler whenever a sequence of commands has been completed and reports the status of each entity in the cell. A command sequence is sent to the robot and, while the commands are carried out, the scheduler simulates the cell operations up to the last input to predict the world state a few minutes in advance. The technique permits fast adjustments to real-world conditions. M.S.K.

A87-16690
TASK BIDDING AND DISTRIBUTED PLANNING IN FLEXIBLE MANUFACTURING
M. J. SHAW (Illinois, University, Urbana) and A. B. WHINSTON (Purdue University, West Lafayette, IN) IN: The engineering of knowledge-based systems; Proceedings of the Second Conference on Artificial Intelligence Applications, Miami Beach, FL, December 11-13, 1985 . Washington, DC, IEEE Computer Society Press, 1985, p. 184-189. refs

This paper applies automatic planning and distributed problem solving methods to the on-line planning and control of cellular flexible manufacturing systems, consisting of asynchronous manufacturing cells. A knowledge-based approach is used to determine the course of action, resource sharing, and processor assignments. Within each cell there is an embedded nonlinear planning system that executes dynamic scheduling and supervises manufacturing operations. Because of the decentralized control, real-time task assignments are carried out by a network-wide bidding procedure among cell hosts. The bidding process is modeled by augmented Petri nets - the combination of production rules and Petri nets - and is executed by a distributed, rule-based algorithm. Author

A87-18423
EXPERT SYSTEMS 85; PROCEEDINGS OF THE FIFTH TECHNICAL CONFERENCE, UNIVERSITY OF WARWICK, ENGLAND, DECEMBER 17-19, 1986
M. MERRY, ED. (Hewlett-Packard Research Laboratories, Bristol, England) Conference sponsored by the British Computer Society. Cambridge and New York, Cambridge University Press, 1985, 342 p. No individual items are abstracted in this volume.

Papers presented at the conference are concerned with the advantages and disadvantages of expert systems, diagnostic expert systems, a model based expert system for hardware troubleshooting, criteria for selecting an inference engine in expert systems, the use of generalized alpha-beta pruning for expert system question selection, the applications of expert system techniques to statistics, knowledge transfer, and VLSI design, the ESCORT system, and knowledge-based planning techniques. Attention is given to allocating abilities to actor systems, choice making in planning systems, the ECO browser, a CAD/CAPP expert system shell, and symbolic uncertain inference and inference under uncertainty. Topics discussed include the SOJA system, real-time multiple-motive expert systems, and control in the open planning architecture. I.F.

A87-18485
AUTOMATION AND ROBOTICS AND THE DEVELOPMENT OF THE SPACE STATION - U.S. CONGRESSIONAL VIEW
M. L. REISS (U.S. Senate, Washington, DC) IN: Space exploitation and utilization; Proceedings of the Symposium, Honolulu, HI, December 15-19, 1985 . San Diego, CA, Univelt, Inc., 1986, p. 531-538.
(AAS PAPER 85-664)

A87-20857* SRI International Corp., Menlo Park, Calif.
PROCEDURAL KNOWLEDGE
MICHAEL P. GEORGEFF and AMY L. LANSKY (SRI International Corp., Artificial Intelligence Center, Menlo Park, CA) IEEE, Proceedings (ISSN 0018-9219), vol. 74, Oct. 1986, p. 1383-1398. refs
(Contract N00014-80-C-0296; N00014-85-C-0251; NAS2-11864)

Much of commonsense knowledge about the real world is in the form of procedures or sequences of actions for achieving particular goals. In this paper, a formalism is presented for representing such knowledge using the notion of process. A declarative semantics for the representation is given, which allows a user to state facts about the effects of doing things in the problem domain of interest. An operational semantics is also provided, which shows how this knowledge can be used to achieve particular goals or to form intentions regarding their achievement. Given both semantics, the formalism additionally serves as an executable specification language suitable for constructing complex systems. A system based on this formalism is described, and examples involving control of an autonomous robot and fault diagnosis for NASA's Space Shuttle are provided. Author

A87-22368#
OVERVIEW OF AL APPLICATIONS FOR SPACE STATION SYSTEMS MANAGEMENT
J. F. SPITZER, D. G. HAMMEN, C. M. KELLY, C. A. MARSH, D. A. MURATORE (Mitre Corp., Houston, TX) et al. AIAA, Aerospace Sciences Meeting, 25th, Reno, NV, Jan. 12-15, 1987. 12 p.
(AIAA PAPER 87-0031)

The use of artificial intelligence for operational management functions on the Space Station is studied. The control of system and fault management on the ground and on the Space Station using automation is examined. The development of an automated integrated system management composed of integrated status assessment, objective management and procedures interpreter

capabilities is discussed. The functions of the integrate display and control, the integrated system management, the intergrated status assessment, the objectives management, the procedures interpreter, and the planning support environment components of the operational management system are described. I.F.

A87-25758
THE ROLE OF EXPERT SYSTEMS ON SPACE STATION
D. R. SLOGGETT (Software Sciences, Ltd.; Environmental and Space Systems Group, Farnborough, England) IN: Space Tech '86; Proceedings of the International Conference, Geneva, Switzerland, May 14-16, 1986 . London, Online International, Ltd., 1986, p. 91-107. refs

The planned deployment of the Space Station, and its associated orbital infrastructure, repreents a unique opportunity to evaluate the potential of expert systems to assist in increasing the autonomy, productivity and effectiveness of the Space Station. This paper seeks to address what current technology can provide to achieve this aim, and highlights previous practical examples of Space AI Systems. The paper makes suggestions for practical research programs, that require urgent attention, to pave the way and demonstrate capability in areas of relatively new technology. From this base the paper suggests some practical areas where AI technology can be applied to the Space Station and their resulting benefits. Specific attention is drawn to the application of expert systems to planning and scheduling and the application of expert monitoring systens to assist in fault diagnosis and repair. The paper concludes that urgent attention is required in the area of demonstration programs where low-risk state-of-the-art developments can be undertaken resulting in very real benefits to the Space Station system. Author

A87-25759
SPACE STATION - THE USE OF EXPERT SYSTEMS FOR PLANNING
JENS GULDBERG and JENS LANGELAND (Computer Resources International A/S, Denmark) IN: Space Tech '86; Proceedings of the International Conference, Geneva, Switzerland, May 14-16, 1986 . London, Online International, Ltd., 1986, p. 109-117. refs

Expert systems have been shown to provide useful techniques for handling planning problems related to the operation of complex systems and to system engineering. A brief review of the principle features of such planning systems is used as a reference for a discussion on relevant applications for the Space Station, which include, e.g., mission planning, scheduling of maintenance, software development, payload design, and check-out procedures. Author

A87-25984
AUTOMATION AND ROBOTICS WITH AEROSPACE APPLICATIONS
D. O. REUDINK (AT&T Bell Laboratories, Holmdel, NJ) IN: Aerospace Applications Conference, Steamboat Springs, CO, Feb. 1-8, 1986, Digest . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, 13 p. refs

A Space Station making extensive use of automation and robotics (A&R) will be more flexible and adaptable than one incorporating fewer A&R features; it will in addition have lower operating costs, improved reliability, and greater autonomy. It is also expected to be capable of performing robot and teleoperator tasks unsuited to humans, such as the assembly of large space structures, due to the hazardous conditions to which they would be exposed. It is accordingly recommended that the NASA Space Station be used as a medium for the promotion of A&R. Attention is presently given to the development status and spinoff advantages of developments in robotic vision. O.C.

A87-26094
ARTIFICIAL INTELLIGENCE AND SIMULATION
WILLARD M. HOLMES, ED. San Diego, CA, Society for Computer Simulation, 1985, 81 p. For individual items see A87-26095 to A87-26097.

The research and development of AI are discussed. Papers are presented on an expert system for chemical process control, an ocean surveillance information fusion expert system, a distributed intelligence system and aircraft pilotage, a procedure for speeding innovation by transferring scientific knowledge more quickly, and syntax programming, expert systems, and real-time fault diagnosis. Consideration is given to an expert system for modeling NASA flight control room usage, simulating aphasia, a method for single neuron recognition of letters, numbers, faces, and certain types of concepts, integrating AI and control system approach, testing an expert system for manufacturing, and the human memory. I.F.

A87-26095
ARTIFICIAL INTELLIGENCE FROM THE SYSTEMS ENGINEER'S VIEWPOINT
ROBERT D. HAWKINS (E-Systems, Fairfax, VA) IN: Artificial intelligence and simulation . San Diego, CA, Society for Computer Simulation, 1985, p. 10-25. refs

The development of AI systems and the use of AI as an engineering methodology are discussed. AI has been applied to national language translation, knowledge-based expert systems, robotics, and computer programming. The development of new AI system using logical, deterministic, statistical, probabilistic, and heuristic methods is examined. Consideration is given to automatic, optimal, adaptive, and learning controls. I.F.

A87-30416#
DATA MANAGEMENT FOR FUTURE SPACE PROJECTS
FRANZ PITTERMANN Dornier Post (English Edition) (ISSN 0012-5563), no. 3, 1986, p. 34-37.

Necessary features of a data management system (DMS) suitable for large-scale future space projects are examined. The European Columbus project is to consist of several subsystems: a manned pressurized module which is attached to the U.S. Space Station; a man-tended free flyer (MTFF) which is composed of a smaller pressurized module and a resource module, with the MTFF able to fly separated from the Space Station and be visited by astronauts for short times; and unmanned free-flying platforms. A suitable DMS would consist of modular subsystems with each module replaceable without interrupting system functions. At a minimum, it would have to be a fail-safe system. Ultimately, DMS development would permit automatic initialization and verification of rendezvous and docking of different spacecraft, replacement of components by robots, repairs, and maintenance. For the spacecraft, the DMS would assume the role of mission planning and control. Components discussed include: computer; interconnection link; data memories; and crew interface. Aspects of the required software technology are considered. D.H.

A87-31112*# National Aeronautics and Space Administration, Washington, D.C.
SECOND AIAA/NASA USAF SYMPOSIUM ON AUTOMATION, ROBOTICS AND ADVANCED COMPUTING FOR THE NATIONAL SPACE PROGRAM
DALE MYERS (NASA, Washington, DC) AIAA, NASA, and USAF, Symposium on Automation, Robotics and Advanced Computing for the National Space Program, 2nd, Arlington, VA, Mar. 9-11, 1987. 4 p.
(AIAA PAPER 87-1655)

An introduction is given to NASA goals in the development of automation (expert systems) and robotics technologies in the Space Station program. Artificial intelligence (AI) has been identified as a means to lowering ground support costs. Telerobotics will enhance space assembly, servicing and repair capabilities, and will be used for an estimated half of the necessary EVA tasks. The general principles guiding NASA in the design, development, ground-testing, interactions with industry and construction of the Space Station component systems are summarized. The telerobotics program has progressed to a point where a telerobot servicer is a firm component of the first Space Station element launch, to support assembly, maintenance and servicing of the Station. The University of Wisconsin has been selected for the establishment of a Center for the Commercial Development of Space, specializing in space automation and robotics. M.S.K.

A87-31116*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA SYSTEMS AUTONOMY DEMONSTRATION PROJECT - DEVELOPMENT OF SPACE STATION AUTOMATION TECHNOLOGY
JOHN S. BULL, RICHARD BROWN, PETER FRIEDLAND, CARLA M. WONG, WILLIAM BATES (NASA, Ames Research Center, Moffett Field, CA) et al. AIAA, NASA, and USAF, Symposium on Automation, Robotics and Advanced Computing for the National Space Program, 2nd, Arlington, VA, Mar. 9-11, 1987. 11 p.
(AIAA PAPER 87-1676)

A 1984 Congressional expansion of the 1958 National Aeronautics and Space Act mandated that NASA conduct programs, as part of the Space Station program, which will yield the U.S. material benefits, particularly in the areas of advanced automation and robotics systems. Demonstration programs are scheduled for automated systems such as the thermal control, expert system coordination of Station subsystems, and automation of multiple subsystems. The programs focus the R&D efforts and provide a gateway for transfer of technology to industry. The NASA Office of Aeronautics and Space Technology is responsible for directing, funding and evaluating the Systems Autonomy Demonstration Project, which will include simulated interactions between novice personnel and astronauts and several automated, expert subsystems to explore the effectiveness of the man-machine interface being developed. Features and progress on the TEXSYS prototype thermal control system expert system are outlined. M.S.K.

A87-31118#
AI APPLICATIONS FOR SPACE SUPPORT AND SATELLITE AUTONOMY
CONSTANCE J. GOLDEN (Ford Aerospace and Communications Corp., Sunnyvale, CA) AIAA, NASA, and USAF, Symposium on Automation, Robotics and Advanced Computing for the National Space Program, 2nd, Arlington, VA, Mar. 9-11, 1987. 8 p.
(AIAA PAPER 87-1682)

The design requirements of knowledge-based systems (KBS) for on-board satellite control systems are explored. Several examples are cited regarding the actions of ground-based humans in maintaining satellite functions through telemetered reprogramming devised on the basis of experience with satellites. Realization of these capabilities in on-board systems requires programming of detailed data on the satellite performance capabilities and on-orbit operational conditions. The hybrid representational approach used in the machine-independent PARAGON expert system development environment is described. PARAGON features graphic displays and a semantic network for concepts, concept characteristics, interactions among domain concepts and the behavior of the concepts. Generic problem-solving inference procedures and levels which can be developed with PARAGON are discussed, along with their limitations for real-time applications. M.S.K.

A87-31120#
NEW CONCEPTS IN TELE-AUTONOMOUS SYSTEMS
LYNN CONWAY, RICHARD VOLZ, and MICHAEL WALKER (Michigan, University, Ann Arbor) AIAA, NASA, and USAF, Symposium on Automation, Robotics and Advanced Computing for the National Space Program, 2nd, Arlington, VA, Mar. 9-11, 1987. 17 p. Research supported by the University of Michigan. refs
(AIAA PAPER 87-1686)

Generic design concepts for semi-autonomous robotic systems amenable to facile human intervention when situations arise that cannot be handled by on-board AI programming are explored. Attention is focused on systems where an operator has a televised view of a robot manipulator controllable with a joystick. Problems inherent in the time delays between command and feedback in long-distance tele-operations can be ameliorated with a local simulation of the robot superimposed over the actual situation. The forward simulation can be used even when no time delays are present, i.e., a time clutch, to disengage the operator actions from the robot actions. A position clutch can disconnect path generation commands from robot actions, allowing the operator to test close maneuvers before translating the simulation into robot motions. A time brake would allow avoidance of robot crashes into obstacles that appear along a generated path. Finally, protocols are described for permitting smooth tradeoffs among human operators or back to the machine AI system. M.S.K.

A87-33867*# National Aeronautics and Space Administration, Washington, D.C.
OVERVIEW OF THE NASA AUTOMATION AND ROBOTICS RESEARCH PROGRAM
LEE HOLCOMB and RON LARSEN (NASA, Washington, DC) IN: Association for Unmanned Vehicle Systems; Annual Meeting, 12th, Anaheim, CA, July 15-17, 1985, Preliminary Proceedings . Washington, DC, Association for Unmanned Vehicle Systems, 1985, 20 p. refs

NASA studies over the last eight years have identified five opportunities for the application of automation and robotics technology: (1) satellite servicing; (2) system monitoring, control, sequencing and diagnosis; (3) space manufacturing; (4) space structure assembly; and (5) planetary rovers. The development of these opportunities entails two technology R&D thrusts: telerobotics and system autonomy; both encompass such concerns as operator interface, task planning and reasoning, control execution, sensing, and systems integration. O.C.

A87-36752
APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN SPACE TRAVEL TECHNOLOGY [MOEGLICHE ANWENDUNGEN VON METHODEN DER KUENSTLICHEN INTELLIGENZ IN DER RAUMFAHRTTECHNIK]
A. R. SEIBL (MBB-ERNO Raumfahrttechnik GmbH, Bremen, West Germany) IN: Yearbook 1986 I; DGLR, Annual Meeting, Munich, West Germany, Oct. 8-10, 1986, Reports . Bonn, Deutsche Gesellschaft fuer Luft- und Raumfahrt, 1986, p. 6-11. In German. refs
(DGLR PAPER 86-099)

The use of artificial intelligence in planned European space projects is discussed. The relevant applications of expert systems are briefly addressed, citing U.S. experience, and an expert systems structure for diagnostic applications is proposed. The man-machine interface is considered, describing the Crew Work Station developed for ESA. C.D.

A87-37195
MECHANICAL DESIGN METHODOLOGY - IMPLICATIONS ON FUTURE DEVELOPMENTS OF COMPUTER-AIDED DESIGN AND KNOWLEDGE-BASED SYSTEMS
DAVID G. ULLMAN and THOMAS A. DIETTERICH (Oregon State University, Corvallis) Engineering with Computers (ISSN 0177-0667), vol. 2, no. 1, 1987, p. 21-29. refs
(Contract NSF DMC-85-14949)

The Current Computer-Aided Design (CAD) and Knowledge-Based Systems (KBS, expert systems) tools are changing mechanical engineering design. Future development and integration of these technologies is dependent on an understanding of the methodology of the mechanical design process, an area of little study and one that is poorly understood. This paper reports on the progress of an effort to understand how practicing engineers perform design. The approach is to record engineers' verbalization of their solution of carefully constructed design problems. The recordings are reduced to determine the intelectual tasks and problem-solving methods used. The results will determine what needed capabilities future intelligent CAD systems will need to aid design engineers. Author

A87-38988
APPLICATIONS OF ARTIFICIAL INTELLIGENCE IV; PROCEEDINGS OF THE MEETING, INNSBRUCK, AUSTRIA, APR. 15, 16, 1986
JOHN F. GILMORE, ED. (Georgia Institute of Technology, Atlanta) Meeting sponsored by SPIE, American Society for Photogrammetry and Remote Sensing, ESA, et al. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings. Volume 657), 1986, 217 p. No individual items are abstracted in this volume.
(SPIE-657)

An expert system for roving robotics; hybrid expert systems in image analysis; the use of PROLOG in automatic speech recognition; a knowledge-based geological prospecting system; the use of AI technology in failsafe real-time systems; computer vision for artificially intelligent robotic systems; and a knowledge representation system for searching trajectories in robotics are examined. Attention is given to using contextual data in classification algorithms; real-time intelligent hardware-based image processing; a parallel intelligent system; a LISP machine; a graphical display intelligence software based on a raster scan; and the extraction of uniform regions with minimization of noise points effects. Topics discussed include an active coordinate imaging system for robot vision; the design of a smart sensor system for real-time remote sensing image processing on-board a satellite; texture defects and visual inspection; the three-dimensional modeling of industrial parts for image analysis; and a new type of cellular turing acceptor. I.F.

A87-40844#
ROBOTS ON THE SPACE STATION
ERIC J. LERNER Aerospace America (ISSN 0740-722X), vol. 25, June 1987, p. 42-45.

Teleoperated robotic devices, or 'telerobots', such as those in use at nuclear processing facilities, are undergoing Space Station applicability evaluations which give attention to such questions as the degree of autonomy feasible or desirable for such devices and their most advantageous location. The mechanical elements of the telerobot are noted to require the most intensive modification for operations in a microgravity environment, due to the presence of backlash in many of its operations. A torque feedback loop has been developed which directly controls the force borne by arm joints. O.C.

A87-41153#
THE CANADIAN ROBOTIC SYSTEM FOR THE SPACE STATION
DOUGLAS CASWELL (National Research Council of Canada, Ottawa) and DEV GOSSAIN (Spar Aerospace, Ltd., Remote Manipulator Systems Div., Toronto, Canada) AIAA, NASA, and USAF, Symposium on Automation, Robotics and Advanced Computing for the National Space Program, 2nd, Arlington, VA, Mar. 9-11, 1987. 6 p.
(AIAA PAPER 87-1677)

The general concept of the Mobile Servicing Center and the Special Purpose Dextrous Manipulator (SPDM), both of which are parts of the Space Station Mobile Servicing System, is described. The role of the SPDM in the assembly and maintenance of the Station and the servicing of payloads and other equipment is outlined. Planning activities for technology diffusion and exploitation of the terrestrial economy are also addressed. C.D.

A87-44760
DEVELOPING A RESEARCH AGENDA FOR ARTIFICIAL INTELLIGENCE IN AEROSPACE MANUFACTURING
WILLIAM M. HENGHOLD (Universal Technology Corp., Dayton, OH), THOMAS TRISCARI, JR. (USAF, Institute of Technology, Wright-Patterson AFB, OH), and VINCENT J. RUSSO (USAF, Materials Laboratory, Wright-Patterson AFB, OH) (IEEE, Artificial Intelligence in Engineering Symposium, George Washington University, Washington, DC, Oct. 21-23, 1985) IEEE Transactions on Systems, Man, and Cybernetics (ISSN 0018-9472), vol. SMC-17, Mar.-Apr. 1987, p. 264-273. refs

A87-44773#
SATELLITE ON-BOARD APPLICATIONS OF EXPERT SYSTEMS
A. CIARLO (ESA, On-Board Data Div., Noordwijk, Netherlands), P. DONZELLI (Si. El S.p.A., Laben Divisione, Milan, Italy), R. KATZENBELSSER (Dornier System GmbH, Friedrichshafen, West Germany), and B. A. MOLLER (CRI, Copenhagen, Denmark) ESA Journal (ISSN 0379-2285), vol. 11, no. 1, 1987, p. 31-44. refs

The article discusses some aspects of the on-board application of expert systems (ES) in artificial satellites. The implementation of two prototypes on a dedicated AI machine are described. Consideration is given to: (1) the interrelationship between the ES and the architecture of the satellite and its impact on the mission-definition phase of the satellite life-cycle; (2) the identification of those tasks that at the current stage seem most likely to be delegated to on-board ES; and (3) the main obstacles that need to be overcome before operational use of ES on-board can take place, and particularly the matters of testing, knowledge collection, and availability of computing resources. Finally, the activities that are currently planned or that appear to be required in the near future to prepare the way for the full exploitation of this technology for satellite autonomy are briefly outlined. Author

A87-53058
AAAIC '86 - AEROSPACE APPLICATIONS OF ARTIFICIAL INTELLIGENCE; PROCEEDINGS OF THE SECOND ANNUAL CONFERENCE, DAYTON, OH, OCT. 14-17, 1986. VOLUME I
Conference sponsored by Systran Corp., Honeywell, Inc., McDonnell-Douglas Corp., et al. Dayton, OH, AAAIC Conference Secretariat, 1986, 272 p. For individual items see A87-53059 to A87-53075.

The present conference on aerospace applications of emerging AI technologies considers topics in spacecraft systems, man/machine interfaces, image analysis and recognition, aircrew aids, personnel training, design automation, command/control/communications applications, AI-based manufacturing and planning, and speculations on AI development trends. Attention is given to AI-based satellite and Space Station autonomy, problems met in the integration of AI into crew systems, AI in diagnostics, real-time pilot-in-the-loop AI, principles of parallel programming, design automation software tools, mission-planning problems biologically motivated AI, architecture-based machine intelligence, and AI in aerospace factory applications. O.C.

A87-53059#
SPACE STATION AUTONOMY - WHAT ARE THE CHALLENGES? HOW CAN THEY BE MET?
RONALD A. HAMMOND (Boeing Computer Services Advanced Technology Center, Seattle, WA) IN: AAAIC '86 - Aerospace Applications of Artificial Intelligence; Proceedings of the Second Annual Conference, Dayton, OH, Oct. 14-17, 1986. Volume 1 . Dayton, OH, AAAIC Conference Secretariat, 1986, p. 2-6. refs

Autonomous systems encompassing knowledge-based systems and robotics for various tasks will be required to aid both the on-orbit and ground support operations of the NASA Space Station. These autonomous systems will reduce human exposure to hazardous environments as well as training requirements and involvement in repetitive tasks. Advanced automation and robotic systems will require advanced operator/system interfaces. Currently envisioned are knowledge-based systems for on-orbit and for ground operations, and robotics for both on-orbit experimental and manufacturing processes, as well as routine orbital 'housekeeping' operations. O.C.

A87-53061*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ARTIFICIAL INTELLIGENCE PLANNING APPLICATIONS FOR SPACE EXPLORATION AND SPACE ROBOTICS
MARK ROKEY and SVEN GRENANDER (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: AAAIC '86 - Aerospace Applications of Artificial Intelligence; Proceedings of the Second Annual Conference, Dayton, OH, Oct. 14-17, 1986. Volume 1 . Dayton, OH, AAAIC Conference Secretariat, 1986, p. 16-21. refs

Mission sequencing involves the plan for actuation of the experiments to be conducted aboard a spacecraft; automation is under study by NASA as a means to reduce time and manpower costs in mission planning and in robotic implementation. The development of a mission sequence is conditioned by the limited duration of advantageous spacecraft encounters with objects of study, more research requests than can be satisfied, and requested changes in objectives. Autonomous robot development is hampered by the absence of task-level programming languages, the existence of anomalies in real-world interactions, and a lack of required capabilities in current sensor technology. O.C.

N87-12277# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Informatics.
TOPICS IN ARTIFICIAL INTELLIGENCE
A. NIJHOLT Jun. 1985 29 p
(INF-85-9; ETN-86-98162) Avail: NTIS HC A03/MF A01

Definitions of artificial intelligence are discussed, and perceptual and cognitive problems are distinguished from problems in robotics. These problems are illustrated. Expert systems, and speech, language, and linguistics are covered. ESA

N87-16778*# Alabama Univ., Huntsville. Dept. of Computer Science.
APPLICATIONS OF ARTIFICIAL INTELLIGENCE TO SCIENTIFIC RESEARCH
MARY ELLEN PRINCE *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer Faculty Fellowship Program 20 p Nov. 1986
Avail: NTIS HC A99/MF E04 CSCL 09B

Artificial intelligence (AI) is a growing field which is just beginning to make an impact on disciplines other than computer science. While a number of military and commercial applications were undertaken in recent years, few attempts were made to apply AI techniques to basic scientific research. There is no inherent reason for the discrepancy. The characteristics of the problem, rather than its domain, determines whether or not it is suitable for an AI approach. Expert system, intelligent tutoring systems, and learning programs are examples of theoretical topics which can be applied to certain areas of scientific research. Further research and experimentation should eventurally make it possible for computers to act as intelligent assistants to scientists. Author

N87-18385# Sandia National Labs., Albuquerque, N. Mex.
USE OF EXPERT SYSTEMS IN SYSTEM STUDIES
J. P. BRANNEN and K. L. HIEBERT-DODD Jun. 1986 79 p
(Contract DE-AC04-76DP-00789)
(DE86-013671; SAND-86-0495) Avail: NTIS HC A05/MF A01

A technique has been developed for including human decision processes in a systems analysis. This technique is applied to an intrusion detection system which consists of sensors which respond to stimuli and the interpretation of these responses by humans. The analysis is carried out via simulations of hardware response to stimuli, simulations of human interpretations of those hardware responses, and a measure of the performance of the total system. While the technique was applied to a particular system, the inclusion of simulations of human decision processes by the use of expert systems is essentially independent of the application. DOE

N87-18387# British Aerospace Dynamics Group, Stevenage (England). Space and Communications Div.
A STUDY OF EXPERT SYSTEMS APPLIED TO SPACE PROJECTS Final Report
N. WARD, comp., J. MURDOCH, comp., and A. EDWARDS, comp. Paris ESA Feb. 1986 68 p
(Contract ESTEC-6027/84-NL-JS)
(BAE-TP-8247; ESA-CR(P)-2297; ETN-87-98951) Avail: NTIS HC A04/MF A01

Potential benefits which expert systems offer the European space industry are discussed. Ground based applications are emphasized. Command, control, and fault diagnosis of spacecraft; the monitoring of complex operations at the launch site; planning and scheduling project work and spacecraft and crew activities; monitoring and control of spacecraft tests; handbook automation; and design are considered. It is clear that expert systems have a useful role to play in all of these areas. Because the space industry is a low volume industry, however, careful consideration must always be given to whether sufficient benefits will accrue from a planned expert system to justify the effort required to build it. A review of progress in the US in developing space-related expert systems, and recommendations on how expert system development should be documented are included. ESA

N87-19911# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
AN ASSESSMENT OF ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS TECHNOLOGY FOR APPLICATION TO MANAGEMENT OF COCKPIT SYSTEMS
WAYNE L. MARTIN Sep. 1986 125 p
(AD-A175456; AAMRL-TR-86-040) Avail: NTIS HC A06/MF A01 CSCL 06D

A review of the literature in the field of artificial intelligence was performed to identify research and development efforts in industry, academia, and government laboratories that may be related (or relatable) to the cockpit management function in tomorrow's aircraft. Individual chapters address the following topics: Chapter 1 - An Introduction to Artificial Intelligence and Expert Systems; Chapter 2 - Artificial Intelligence Development Applications in DARPA, DOD, and NASA; Chapter 3 - State-of-the-Art Review and Projection of Future Expert System Developments; Chapter 4 - Human Factors Research in Artificial Intelligence and Expert Systems; Chapter 5 - Image Understanding; Chapter 6 - Natural Language Processing/Understanding; and Chapter 7 - Summary Comments on the Development and Application of Artificial Intelligence and Expert Systems. Separate bibliographies are provided at the end of each chapter to assist the reader in identifying specific literature of interest. A glossary of abbreviations, acronyms, and special terms used in the context of this report is also provided. GRA

N87-22240# Oak Ridge National Lab., Tenn.
MANIPULATOR TECHNOLOGY: THE CRITICAL ELEMENT OF USEFUL AUTONOMOUS WORKING MACHINES
W. R. HAMEL and S. M. BABCOCK 1986 13 p Presented at the Intelligent Autonomous Systems International Conference, Amsterdam, Netherlands, 8 Dec. 1986
(Contract DE-AC05-84OR-21400)
(DE87-003657; CONF-861265-1) Avail: NTIS MF A01

The structure and characteristics of mobile autonomous robots which can perform useful work are discussed. The objective of the discussion is to assess the state of the technology particularly with regard to robot mechanization and the implementation of a human-like performance capability. Technology limitations in manipulators and locomotion are significant. If not task constrained, it appears that an anthropomorphic autonomous robot would likely be much larger physically and an order of magnitude heavier than a human equivalent. Research in high-performance, lightweight manipulators, servoactuators, and power supply systems is needed. DOE

N87-29139*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PROGRESS IN KNOWLEDGE REPRESENTATION RESEARCH
HENRY LUM *In* NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 1 29 p Aug. 1985
Avail: NTIS HC A16/MF A01 CSCL 09B

Brief descriptions are given of research being carried out in the field of knowledge representation. Dynamic simulation and modelling of planning systems with real-time sensor inputs; development of domain-independent knowledge representation tools which can be used in the development of application-specific expert and planning systems; and development of a space-borne very high speed integrated circuit processor are among the projects discussed. R.J.F.

N87-29140*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AI AT AMES: ARTIFICIAL INTELLIGENCE RESEARCH AND APPLICATION AT NASA AMES RESEARCH CENTER, MOFFETT FIELD, CALIFORNIA, FEBRUARY 1985
ALISON E. ANDREWS, ed. *In* NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 1 27 p Aug. 1985
Avail: NTIS HC A16/MF A01 CSCL 09B

Charts are given that illustrate function versus domain for artificial intelligence (AI) applications and interests and research area versus project number for AI research. A list is given of project titles with associated project numbers and page numbers. Also, project descriptions, including title, participants, and status are given. Author

N87-29831# Oak Ridge National Lab., Tenn.
EXPERIMENTS IN AUTONOMOUS ROBOTICS
W. R. HAMEL 1987 7 p Presented at the 5th Symposium on Energy Engineering Sciences, Argonne, Ill., 17 Jun. 1987
(Contract DE-AC05-84OR-21400)
(DE87-010893; CONF-870679-2; CESAR-87/21) Avail: NTIS HC A02/MF A01

The Center for Engineering Systems Advanced Research (CESAR) is performing basic research in autonomous robotics for energy-related applications in hazardous environments. The CESAR research agenda includes a strong experimental component to assure practical evaluation of new concepts and theories. An evolutionary sequence of mobile research robots has been planned to support research in robot navigation, world sensing, and object manipulation. A number of experiments have been performed in studying robot navigation and path planning with planar sonar sensing. Future experiments will address more complex tasks involving three-dimensional sensing, dexterous manipulation, and human-scale operations. DOE

N87-29866*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
TELEROBOTIC WORK SYSTEM: CONCEPT DEVELOPMENT AND EVOLUTION
LYLE M. JENKINS *In its* The 21st Aerospace Mechanisms Symposium p 103-110 May 1987
Avail: NTIS HC A16/MF A01 CSCL 05H

The basic concept of a telerobotic work system (TWS) consists of two dexterous manipulator arms controlled from a remote station. The term telerobotic describes a system that is a combination of teleoperator control and robotic operation. Work represents the function of producing physical changes. System describes the integration of components and subsystems to effectively accomplish the needed mission. Telerobotics reduces exposure to hazards for flight crewmembers and increases their productivity. The requirements for the TWS are derived from both the mission needs and the functional capabilities of existing hardware and software to meet those needs. The development of the TWS is discussed. Author

N87-30091# Science Applications International Corp., Arlington, Va.
PROCEEDINGS OF A WORKSHOP ON KNOWLEDGE-BASED SYSTEMS Annual Report, Apr. 1986 - Apr. 1987
LEE S. BAUMANN Apr. 1987 201 p
(Contract N00014-86-C-0700; ARPA ORDER 5605)
(AD-A183430; SAIC-87/1069) Avail: NTIS HC A10/MF A01 CSCL 12E

The report of a workshop on Knowledge-based Systems contains the following: Semantically Sound Inheritance for a Formally Defined Frame Language with Defaults; Module-Oriented Programming in ABE: Modules and Abstract Datatypes; Annual Report of the Experimental Knowledge Systems Laboratory; On Making Expert Systems More Like Experts; The Loom Knowledge Representation Language; A Framework for Situation Assessment: Using Best-Explanation Reasoning to Infer Plans from Behavior; Concurrency in Abductive Reasoning; an Experiment in Knowledge-Based Signal Understanding Using Parallel Architectures; An Instrumented Architectural Simulation System; Considerations for Multiprocessor Topologies; RUM: A Layered Architecture for Reasoning with Uncertainty; Progress in Reasoning with Incomplete and Uncertain Information Part I: Reasoning with Uncertainty; Part II: Analogical Reasoning; Part III: Reasoning with Incomplete Information; An Algebraic Foundation for Truth Maintenance; Logics of Justified Belief; Using T-norm Based Uncertainty Calculi in a Naval Situation Assessment Application; A role for Assumption Based and Nonmonotonic; Justifications in Automating Strategic Threat Analysis, and a Mathematical Theory for Diagnosis Based on the MONAD Concept. GRA

N87-30101# Oak Ridge National Lab., Tenn.
FREQUENCY-CODED ARTIFICIAL NEURAL NETWORKS: AN APPROACH TO SELF-ORGANIZING SYSTEMS
W. B. DRESS 1987 9 p Presented at the 1st IEEE International Conference on Neural Networks, San Diego, Calif., 21 Jun. 1987
(Contract DE-AC05-84OR-21400)
(DE87-011122; CONF-8706130-2) Avail: NTIS HC A02/MF A01

A frequency-based model of an artificial neural network is being explored for active learning in a simulated environment and for its response to multiple modalities of input data. Physical sensors couple naturally to such a network, providing an easy migration path from simulation to application. The combination of an artificial neural network processing frequency-coded sensor information and implemented on advanced computer architectures is seen as an answer to the problems arising in robotics and the fusion of large quantities of multisensory data. DOE

N87-30104# Yale Univ., New Haven, Conn. Dept. of Computer Science.
TEN PROBLEMS IN ARTIFICIAL INTELLIGENCE
ROGER C. SCHANK and CHRISTOPHER C. OWENS Jan. 1987 36 p
(Contract N00014-85-K-0108; AF-AFOSR-0343-85)
(AD-A183552; YALEU/CSD/RR-514) Avail: NTIS HC A03/MF A01 CSCL 09B

Researchers in Artificial Intelligence have had a difficult time defining the field's goals and assessing its progress. Some have focused on the task of modelling the human brain, others have focused on developing smart machines independent of the constraints of psychological or neurological realism. Over the years the notion of what is an AI task has changed, as problems once thought to be easy have turned out to be hard, and vice versa. This paper discusses some problems that are currently of interest to the field, and places them in the context of a more enduring question: What is intelligence? It attempts to enumerate a few essential aspects of intelligence that every human, animal or intelligent machine must, to some degree, exhibit. GRA

05

COMPUTERS AND INFORMATION MANAGEMENT

Includes Information Systems and Theory, Information Dissemination and Retrieval, Management Information Systems, Database Management Systems and Databases, Data Processing, Data Management, Communications and Communication Theory, Documentation and Information Presentation, Software, Software Acquisition, Software Engineering and Management, Computer Systems Design and Performance, Configuration Management (Computers), Networking, Office Automation, Information Security.

A87-10029* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
KNOWLEDGE BASED PROGRAMMING AT KSC
J. H. TULLEY, JR. (NASA, Kennedy Space Center; Lockheed Space Operations Co., Cocoa Beach, FL) and C. I. DELAUNE (NASA, Kennedy Space Center, Cocoa Beach, FL) IN: Space Congress, 23rd, Cocoa Beach, FL, April 22-25, 1986, Proceedings . Cape Canaveral, FL, Canaveral Council of Technical Societies, 1986, p. 2-28 to 2-32. refs

Various KSC knowledge-based systems projects are discussed. The objectives of the knowledge-based automatic test equipment and Shuttle connector analysis network projects are described. It is observed that knowledge-based programs must handle factual and expert knowledge; the characteristics of these two types of knowledge are examined. Applications for the knowledge-based programming technique are considered. I.F.

A87-10373
MICRO COMPUTER-BASED GEOGRAPHIC INFORMATION SYSTEM TECHNOLOGY FOR RESOURCE ASSESSMENT AND RURAL DEVELOPMENT PLANNING
G. SCHULTINK (Michigan State University, East Lansing) Geocarto International, no. 2, 1986, p. 33-43.

A87-11777*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SCIENTIFIC COMPUTING ENVIRONMENT FOR THE 1980S
F. R. BAILEY (NASA, Ames Research Center, Moffett Field, CA) IN: Numerical methods for engine-airframe integration . New York, American Institute of Aeronautics and Astronautics, Inc., 1986, p. 3-23.

An emerging scientific computing environment in which computers are used not only to solve large-scale models, but are also integrated into the daily activities of scientists and engineers, is discussed. The requirements of the scientific user in this environment are reviewed, and the hardware environment is described, including supercomputers, work stations, mass storage, and communications. Significant increases in memory capacity to keep pace with performance increases, the introduction of powerful graphics displays into the work station, and networking to integrate many computers are stressed. The emerging system software environment is considered, including the operating systems, communications software, and languages. New scientific user tools and utilities that will become available are described. C.D.

A87-14595
SOFTWARE SYSTEMS DEVELOPMENT COSTING AND SCHEDULING MODELS
W. G. CHEADLE (Martin Marietta Corp., Denver, CO) IN: International Society of Parametric Analysts, Annual Conference, 7th, Orlando, FL, May 7-9, 1985, Proceedings. Volume 4, Number 1 . McLean, VA, International Society of Parametric Analysts, 1986, p. 74-79, 83-103.

An examination is given of necessary changes that must be incorporated into the available models that industry and government presently subscribe to for projecting software costs. The use of the Ada language alone has made a big difference in the software development life cycle. Three different system development approaches are discussed in detail: the traditional approach where the development time is expected to be five years or longer, the pre-planned program improvements approach, and the evolutionary acquisition approach. DoD-STD-1679A and MIL-STD-SDS documentation should be used on the first two approaches, but is a 'must' on all evolutionary acquisition approach developments. D.H.

A87-14596
THE USE OF SOFTWARE METRICS TO IMPROVE PROJECT ESTIMATION
B. GRADY and D. CASWELL (Hewlett-Packard, Software Engineering Laboratory, Palo Alto, CA) IN: International Society of Parametric Analysts, Annual Conference, 7th, Orlando, FL, May 7-9, 1985, Proceedings. Volume 4, Number 1 . McLean, VA, International Society of Parametric Analysts, 1986, p. 129-144.

A company-wide program has been put into effect at Hewlett-Packard to measure and improve the process of developing software. One of the objectives, attained quite quickly, was to use measurements to achieve short-term improvements in productivity and quality. Various efforts during the first year of measurements are reviewed, which led to significant development process changes and a greater awareness of which elements to monitor. The heart of the program was the establishment of process metrics, based on one year's experience with 100 projects. The five standard metrics derived include: size; people/time/cost; defects; difficulty; and communications. D.H.

A87-15416#
DEVELOPING RELIABLE SPACE FLIGHT SOFTWARE
E. KOSS IN: 1986 Annual Reliability and Maintainability Symposium, Las Vegas, NV, January 28-30, 1986, Proceedings . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 171-176. refs

The core software engineering tasks central to the development of reliable spaceflight software are explored. Mid-1980s mature software has up to 75,000 instructions, and mid-1990s space-rated software may require 200,000-250,000 instructions (costing several thousand dollars per line). Techniques which can be implemented to reduce the software error count are delineated, noting the importance of testing actual flight software, especially flight-critical software. M.S.K.

A87-15849*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EARTH OBSERVING SYSTEM - CONCEPTS AND IMPLEMENTATION STRATEGY
R. E. HARTLE (NASA, Goddard Space Flight Center, Greenbelt, MD) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 9 p. refs
(IAF PAPER 86-72)

The concepts of an Earth Observing System (EOS), an information system being developed by the EOS Science and Mission Requirements Working Group for international use and planned to begin in the 1990s, are discussed. The EOS is designed to study the factors that control the earth's hydrologic cycle, biochemical cycles, and climatologic processes by combining the measurements from remote sensing instruments, in situ measurement devices, and a data and information system. Three EOS platforms are planned to be launched into low, polar, sun-synchronous orbits during the Space Station's Initial Operating Configuration, one to be provided by ESA and two by the United States. I.S.

A87-16797
A CREDIBLE METHOD FOR COSTING SOFTWARE CHANGES
H. VILLARREAL, JR. (Honeywell, Inc., Minneapolis, MN) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3 . New York, Institute of Electrical and Electronics Engineers, 1986, p. 700-706.

A technique is presented for assessing the cost of software changes at any point in the software life cycle. The method involves, initially, assigning an ID number to the title of each change and

then describing each change in terms of the expected magnitude of impact on other software modules after identifying which modules will be effected. The calculations are performed using a microcomputer and a spreadsheet program, which tracks the required increases in tasks and the man-months and man-days needed for the changes. Account is taken of the labor rates and the total amount of hours needed to implement each change.
M.S.K.

A87-18852
AEROSPACE COMPUTER SECURITY CONFERENCE, 2ND, MCLEAN, VA, DECEMBER 2-4, 1986, TECHNICAL PAPERS
Conference sponsored by AIAA, American Society for Industrial Security, and DOD Computer Institute. New York, American Institute of Aeronautics and Astronautics, 1986, 142 p. For individual items see A87-18853 to A87-18865.

Papers are presented on a model for the containment of computer viruses, the Commercial Communications Security Endorsement Program, and a design for a multilevel secure database management system. Topics discussed include secure computer systems, electronic mail privacy enhancement, multilevel data storage design, and secure database management system architectural analysis. Particular attention is given to access control and privacy in large distributed systems and the verification of integrity.
I.F.

A87-18855#
A PRACTICAL DESIGN FOR A MULTILEVEL SECURE DATABASE MANAGEMENT SYSTEM
B. B. DILLAWAY and J. T. HAIGH (Honeywell Secure Computing Technology Center, Saint Anthony, MN) IN: Aerospace Computer Security Conference, 2nd, McLean, VA, December 2-4, 1986, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1986, p. 44-57. refs
(Contract F30602-86-C-0003)
(AIAA PAPER 86-2771)

The problems inherent in the design of secure database management systems are described. Past attempts at solving these problems are reviewed briefly, and a new approach is described. It is based on the SAT type enforcement mechanism and two extensions to the basic SAT security policy.
Author

A87-18858#
GOOD SECURITY PRACTICES FOR I/S NETWORKS
L. W. MEHRMANN (IBM Corp., Irving, TX) IN: Aerospace Computer Security Conference, 2nd, McLean, VA, December 2-4, 1986, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1986, p. 73-79.
(AIAA PAPER 86-2775)

Concepts for identifying and limiting security risks in information systems (I/O) networks are studied. The basic objectives of a good security program and network security are described. Network security risk and controls in an I/O environment are examined from a managerial prespective. The roles of physical access, logical access, organizational, personnel, operational, application development, and work station controls, and data transmission protection in the I/O environment are discussed; the operations of these controls in a specific network environment are considered.
I.F.

A87-18863#
COMPUTER SECURITY ACQUISITION MANAGEMENT
H. O. LUBBES and B. STAUFFER IN: Aerospace Computer Security Conference, 2nd, McLean, VA, December 2-4, 1986, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1986, p. 114-119.
(AIAA PAPER 86-2774)

Implementing computer security into the procurement of a Mission Critical System (MCS) is a life cycle process. The process begins with the definition of security requirements during Concept Exploration and continues through deployment to Accreditation of the installation. Throughout, the project manager is faced with technical trade-off decisions, financial issues and perhaps changing functional requirements. This paper presents a consistent life cycle view of the computer security management functions involved in acquisition of MCS.
Author

A87-18865#
COMPUTER SECURITY AND USER AUTHENTICATION - OLD PROBLEMS, NEW SOLUTIONS
J.-C. SPENDER (Enigma Logic, Inc., Concord, CA) IN: Aerospace Computer Security Conference, 2nd, McLean, VA, December 2-4, 1986, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1986, p. 126-132.
(AIAA PAPER 86-2760)

This paper discusses the use of hand-held authentication devices. The devices offer a new solution to the old problem of securely identifying computer users. The technology has two parts; the authentication device or 'key', and the software or firmware 'lock' that teaches a system to look for the key. The alternative lock and key interactions are explained. Some of the problems presented by the technology, designing keys, designing locks, managing the lock, finding where to locate the lock in the host system, and managing the population of keys, are addressed. User and organizational reactions to this technology, are discussed.
Author

A87-23084
PARALLEL PROCESSOR SIMULATION WITH ESL
J. L. HAY (Salford, University, England) and R. E. CROSBIE (California State University, Chico) IN: 1986 Summer Computer Simulation Conference, Reno, NV, July 28-30, 1986, Proceedings . San Diego, CA, Society for Computer Simulation, 1986, p. 959-964. refs

The background, objectives, and outstanding features of an advanced continuous-system simulation language, ESA's Simulation Language (ESL), are discussed. The programming concepts of ESL include separate program units to describe the system and the experiment to be performed on the unit; modular model concepts in the form of submodels to define independent parts of the system; a segment facility which allows sections of the system to be simulated on a parallel processor emulation; techniques for describing and handling system discontinuities; and modern programming structure features with comprehensive procedural code facilities. The advanced segmentation features of the ESL are examined in detail, and a number of parallel processor problems and their solutions are discussed.
I.S.

A87-23263#
DATABASE APPLICATION TO AIRCRAFT ENGINEERING FUNCTIONS RELATED TO FLIGHT TESTING
JEROME S. KOHN and JULIUS PANGILINAN (Grumman Corp., Aircraft Systems Div., Bethpage, NY) AIAA, AHS, CASI, DGLR, IES, ISA, ITEA, SETP, and SFTE, Flight Testing Conference, 3rd, Las Vegas, NV, Apr. 2-4, 1986. 9 p.
(AIAA PAPER 86-9823)

Attention is given to a database management system currently being developed to provide data control for aircraft engineering groups that produce and evaluate information on planned test conditions, analyze test flight data and provide performance guarantees. Similar capabilities will be offered to flight test organizations who integrate all test requirements, operate complex recording, telemetry, and data output systems, and assume the responsibilities of performance demonstration and flight safety. It is noted that the database system will be structured so that both organizations can control, share, use, and transmit flight test related data in the on-line computer environment.
K.K.

A87-31113#
ISSUES AND THEMES IN INFORMATION SCIENCE AND TECHNOLOGY
SAUL AMAREL (DARPA, Information Science and Technology Office, Arlington, VA) AIAA, NASA, and USAF, Symposium on Automation, Robotics and Advanced Computing for the National Space Program, 2nd, Arlington, VA, Mar. 9-11, 1987. 3 p.
(AIAA PAPER 87-1661)

The VLSIC and networking technologies and the goals of current research by DARPA are discussed. Multiprocessor architectures have been devised which are potentially useful for vision, speech, complex symbolic processing and large scientific problems, provided appropriate computational paradigms are developed which exploit the parallel processing architectures. AI development efforts are being directed at producing systems which can solve real-life problems, with basic research still being performed on representation, reasoning, learning and discovery, and on frameworks for designing and implementing AI systems, particularly software development systems. Efforts are being expended to expand the ARPANET computer network to enhance collaborative research and engineering productivity. The CAD techniques developed to define the VLSICs have industrial applications for mechanical parts and processes. Advanced robotic projects include work on an autonomous land rover. Finally, expanded R&D on teaching and training systems and on adaptive man-machine interfaces are recommended. M.S.K.

A87-31121#
SOFTWARE ARCHITECTURE FOR MANUFACTURING AND SPACE ROBOTICS
J. S. ALBUS, R. LUMIA, and H. MCCAIN (NBS, Robot Systems Div., Gaithersburg, MD) AIAA, NASA, and USAF, Symposium on Automation, Robotics and Advanced Computing for the National Space Program, 2nd, Arlington, VA, Mar. 9-11, 1987. 11 p. refs
(AIAA PAPER 87-1687)

A hierarchical architecture is described which supports Space Station telerobots in a variety of modes. The system is divided into three hierarchies: task decomposition, world model, and sensor processing. Goals at each level of the task decomposition hierarchy are divided both spatially and temporally into simpler commands for the next lower level. This decomposition is repeated until, at the lowest level, the drive signals to the robot actuators are generated. To accomplish its goals, task decomposition modules must often use information stored in the world model. The purpose of the sensory system is to update the world model as rapidly as possible to keep the model in registration with the physical world. This paper describes the architecture of the entire control system hierarchy and how it can be applied to space telerobot applications. Author

A87-31136* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SOFTWARE TESTING - A WAY TO IMPROVE SOFTWARE RELIABILITY
ANDY MAHINDRU (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: IEEE, Annual International Phoenix Conference on Computers and Communications, 5th, Scottsdale, AZ, Mar. 26-28, 1986, Proceedings. Washington, DC, IEEE Computer Society Press, 1986, p. 425-432. refs

Various software testing techniques are described. The techniques are classified as dynamic or static, structural or functional, and manual or automated. The objects tested include the elements designed during the development of the software, such as codes, data structures, and requirements. Testing techniques and procedures applicable to each phase of software development are examined; the development phases are: software requirements analysis, preliminary design, detailed design, coding, testing, and operation and maintenance. The characteristics of a future software engineering environment for software testing and validation are discussed. I.F.

A87-31452
SOFTWARE INVESTMENT MANAGEMENT
LAWRENCE H. PUTNAM and DOUGLAS T. PUTNAM (Quantitative Software Management, Inc., McLean, VA) IN: Digital Avionics Systems Conference, 7th, Fort Worth, TX, Oct. 13-16, 1986, Proceedings . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 3-12. refs

This paper shows that there is a simple management productivity equation that relates the developed functionality to the organizational software efficiency and the required schedule and effort. It does this in simple management terms. The key parameters are a Productivity Index and Manpower Buildup Index. The Productivity Index is the capital investment term in software development; the Manpower Buildup Index characterizes an organization's software building style. Both can be directly influenced by management's policies and decisions. Because of exploitable nonlinearities in the algorithms, management can gain very large financial leverage. The paper illustrates this behavior and suggests ways to exploit it. Author

A87-31616#
SUPERCOMPUTER MAKERS OF TOKYO
NEIL DAVIS Aerospace America (ISSN 0740-722X), vol. 25, March 1987, p. 30, 31, 34.

Computers manufactured by the Japanese companies NEC, Hitachi and Fujitsu are encroaching on the capabilities of supercomputers produced by Cray. The Japan National Aerospace Lab is to receive a supercomputer, while other machines are being applied to fast breeder reactor and fusion studies. A 140 Mflop device is being used by a jet-engine and turbo-pump manufacturer and several national universities are buying mainframes for cut-rate prices from Japanese manufacturers who wish to encourage engineering students to work for the manufacturers. A Cray X-MP is now owned by Nissan and used to accelerate car R&D. The same company will design and produce the strap-on boosters for the H-II launch vehicle. Also noted are research efforts to develop machines an order of magnitude more powerful than current supercomputers. M.S.K.

A87-34543* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ISSUES IN PACKET RADIO NETWORK DESIGN
BARRY M. LEINER (NASA, Ames Research Center, Moffett Field, CA), DONALD L. NIELSON (SRI International, Menlo Park, CA), and FOUAD A. TOBAGI (Stanford University, CA) IEEE, Proceedings (ISSN 0018-9219), vol. 75, Jan. 1987, p. 6-20. refs

The physical aspects of a packet radio network design, the automated management of the network, and the interface of the network to the users are examined. The networks provide data communications to users located over a broad geographic region where direct radio or wire connection between the source and destination user is not practical; the network consists of a radio, antenna, and digital controller. The physical connectivity, bandwidth-time-space management, channel access, and data link control of the network are analyzed. Consideration is given to link determination and control, routing and packet forwarding, congestion and flow control, and supported users management. The operation and management of a packet radio network, in particular network deployment and maintenance, network access methods, and its effect on the radio spectrum, are discussed. The performance and cost of a packet radio network are evaluated. I.F.

A87-34722* NASA Scientific and Technical Information Facility, Baltimore/Washington International Airport, Md. 21240.
CURRENT AND FUTURE TRANSLATION TRENDS IN AERONAUTICS AND ASTRONAUTICS
TIMOTHY ROWE (NASA, Scientific and Technical Information Facility, Linthicum Heights, MD) IN: American Translators Association Scholarly Monograph Series. Volume 1. Binghamton, NY, SUNY, University Center, 1986, p. 1-20. refs

The pattern of translation activity in aeronautics and astronautics is reviewed. It is argued that the international nature of the

aerospace industry and the commercialization of space have increased the need for the translation of scientific literature in the aerospace field. Various factors which can affect the quality of translations are examined. The need to translate the activities of the Soviets, Germans, and French in materials science in microgravity, of the Japanese, Germans, and French in the development of industrial ceramics, and of the Chinese in launching and communications satellites is discussed. It is noted that due to increases in multilateral and bilateral relationships in the aerospace industry, the amount of translation from non-English source material into non-English text will increase and the most important languages will be French and German, with an increasing demand for Japanese, Chinese, Spanish, and Italian translations. I.F.

A87-35661
THE JAPANESE NATIONAL PROJECT FOR NEW GENERATION SUPERCOMPUTING SYSTEMS
TOSHITSUGU YUBA and HIROSHI KASHIWAGI (Ministry of International Trade and Industry, Electrotechnical Laboratory, Sakura, Japan) Parallel Computing (ISSN 0167-8191), vol. 4, Feb. 1987, p. 1-16. refs

This paper reviews the current status of the R&D of the Japanese national project for new generation supercomputing systems. The project identifies the basic technology for ultrahigh speed supercomputers based on parallel processing with new devices. The target system is expected to operate at more than 10 Gflops. In this paper, the R&D on computer architecture is emphasized from the viewpoint of parallel processing. Author

A87-37293*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SPACE STATION DATA MANAGEMENT SYSTEM ARCHITECTURE
WILLIAM E. MALLARY and VIRGINIA A. WHITELAW (NASA, Johnson Space Center, Houston, TX) IEEE, Proceedings (ISSN 0018-9219), vol. 75, March 1987, p. 320-328.

Within the Space Station program, the Data Management System (DMS) functions in a dual role. First, it provides the hardware resources and software services which support the data processing, data communications, and data storage functions of the onboard subsystems and payloads. Second, it functions as an integrating entity which provides a common operating environment and human-machine interface for the operation and control of the orbiting Space Station systems and payloads by both the crew and the ground operators. This paper discusses the evolution and derivation of the requirements and issues which have had significant effect on the design of the Space Station DMS, describes the DMS components and services which support system and payload operations, and presents the current architectural view of the system as it exists in October 1986; one-and-a-half years into the Space Station Phase B Definition and Preliminary Design Study. Author

A87-37550
ADA - FROM PROMISE TO PRACTICE?
JOHN VOELCKER IEEE Spectrum (ISSN 0018-9235), vol. 24, April 1987, p. 44-49.

Ada development systems break sections of code into reusable modules that allow users to rank the priority of jobs and tasks performed by the entire system; this modularity is suitable to the clearly defined priorities of advanced military aircraft computerized control systems. With Ada, the user can also define generics, or general processing routines to handle variables of various types that include data and subroutines. However, Ada's rigid definitions are sometimes a drawback to those who must create development systems for the language; Ada lacks such development tools as debuggers and cross-reference programs. A compiler must be validated separately for each of its target systems. O.C.

A87-39900
THE AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS LIBRARY - SERVING A SOCIETY AND THE AEROSPACE COMMUNITY
BARBARA LAWRENCE (AIAA, Technical Information Service, New York) Science and Technology Libraries (ISSN 0194-262X), vol. 7, no. 2, 1986, p. 7-14.

Now in its fiftieth year, the American Institute of Aeronautics and Astronautics Library's role has evolved to serve the Institute, NASA, and the worldwide aerospace community. As a major aerospace information resource, the Library provides services to members, professionals, students, amateurs, and other libraries. These services, described briefly, include document delivery, microfiche subscriptions, reference and searching. Author

A87-42279
RECENT ADVANCES IN OPTICAL COMPUTING IN JAPAN
SATOSHI ISHIHARA (Ministry of International Trade and Industry, Electrotechnical Laboratory, Tsukuba, Japan) IN: Optical and hybrid computing; Proceedings of the Meeting, Leesburg, VA, Mar. 24-27, 1986 . Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1987, p. 31-50. refs

The results of recent Japanese research in optical and hybrid computer systems and components are summarized and illustrated with drawings and diagrams, and the organizational structure of the research efforts is outlined. Topics addressed include optical logic devices, spatial light modulators, two-dimensional lasers, optical bistable devices, device theory, optically controlled array processing, an optical bus for a multiprocessor system, real-time multiple-matrix-product processing, optical numerical processing, optical parallel-array logic systems, optical associative memory, and neural-network computation. Consideration is given to the roles of the Optical Computer Group of the Japan Society of Applied Physics, industry, and government (through the universities and Ministry of Education and through the Ministry of International Trade and Industry). T.K.

A87-44414
THE ROLE OF LOGIC PROGRAMMING IN THE FIFTH GENERATION COMPUTER PROJECT
KAZUHIRO FUCHI and KOICHI FURUKAWA (ICOT Research Center, Tokyo, Japan) New Generation Computing (ISSN 0288-3635), vol. 5, no. 1, 1987, p. 3-28. refs

The main results of the work of the Fifth Generation Computer Project in software research, hardware research, and the development of software tools for research and development are reviewed. Trends and noteworthy results in related research around the world are summarized. Research topics for the future are considered, emphasizing the importance of international cooperation. C.D.

A87-45476
GLOBECOM '86 - GLOBAL TELECOMMUNICATIONS CONFERENCE, HOUSTON, TX, DEC. 1-4, 1986, CONFERENCE RECORD. VOLUMES 1, 2, & 3
Conference sponsored by IEEE. New York, Institute of Electrical and Electronics Engineers, Inc., 1986. Vol. 1, 664 p.; vol. 2, 619 p.; vol. 3, 660—p. For individual items see A87-45477 to A87-45559.

Papers are presented on local area networks; formal methods for communication protocols; computer simulation of communication systems; spread spectrum and coded communications; tropical radio propagation; VLSI for communications; strategies for increasing software productivity; multiple access communications; advanced communication satellite technologies; and spread spectrum systems. Topics discussed include Space Station communication and tracking development and design; transmission networks; modulation; data communications; computer network protocols and performance; and coding and synchronization. Consideration is given to free space optical communications systems; VSAT communication networks; network topology design; advances in adaptive filtering echo cancellation and adaptive equalization; advanced signal

processing for satellite communications; the elements, design, and analysis of fiber-optic networks; and advances in digital microwave systems. I.F.

A87-48590#
DATA MANAGEMENT STANDARDS FOR SPACE INFORMATION SYSTEMS
R. DES JARDINS (Computer Technology Associates, Inc., McLean, VA) and C. MAZZA (ESA, European Space Operations Centre, Darmstadt, West Germany) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 7 p.
(AIAA PAPER 87-2205)

Data management - that is, storing, describing and retrieving data - is a special problem for the high performance bit-efficient information systems required for space missions. This paper presents a summary description of data management for space information systems, and describes four specific problem areas that can benefit from data management standards in the Space Station era: data description, data capture, data interchange, and data interpretation. In each area, a recommended modern data management standard or related technique is described as an example recommendation for future space information systems. The paper concludes with a recommendation that space agencies develop testbed validations of these 'new' approaches to data management. Author

A87-48592#
ESA SOFTWARE ENGINEERING STANDARDS FOR FUTURE PROGRAMMES
C. MAZZA (ESA, European Space Operations Centre, Darmstadt, West Germany) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 7 p. refs
(AIAA PAPER 87-2207)

ESA has established since several years a board for software standardization which has developed and promoted the ESA Software Engineering Standards. These Standards have been in use now for 3 years on several software projects and subsequently reviewed. The last issue will constitute the baseline for software standards for all ESA future missions. The essential principles on which the standards are based are explained. ESA has also formulated a policy for the choice of programming languages for future projects and for the selection of a European Space Software Development Environment which will support the above standards and the selected languages. Author

A87-48593*# National Aeronautics and Space Administration, Washington, D.C.
THE SPACE STATION SOFTWARE SUPPORT ENVIRONMENT - NOT JUST WHAT, BUT WHY
JOHN R. GARMAN (NASA, Space Station Program Office, Washington, DC) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 9 p. refs
(AIAA PAPER 87-2208)

The NASA environment is described with attention given to mission data systems in NASA and the strategic view. Space Station data systems are characterized into the following: distributed data systems, functionality and complexity, session oriented user interface, and distributed software development. The concept of a support software environment within the Space Station Program is elucidated and a strategic model for integrated data processing is presented. K.K.

A87-48597*# Ford Aerospace and Communications Corp., College Park, Md.
INTEGRATED SCHEDULING AND RESOURCE MANAGEMENT
M. T. WARD (Ford Aerospace and Communications Corp., College Park, MD) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 11 p. refs
(Contract NAS5-2750)
(AIAA PAPER 87-2213)

This paper examines the problem of integrated scheduling during the Space Station era. Scheduling for Space Station entails coordinating the support of many distributed users who are sharing common resources and pursuing individual and sometimes conflicting objectives. This paper compares the scheduling integration problems of current missions with those anticipated for the Space Station era. It examines the facilities and the proposed operations environment for Space Station. It concludes that the pattern of interdependecies among the users and facilities, which are the source of the integration problem is well structured, allowing a dividing of the larger problem into smaller problems. It proposes an architecture to support integrated scheduling by scheduling efficiently at local facilities as a function of dependencies with other facilities of the program. A prototype is described that is being developed to demonstrate this integration concept. Author

A87-48600*# National Aeronautics and Space Administration, Washington, D.C.
TECHNICAL AND MANAGEMENT INFORMATION SYSTEM (TMIS)
TIMOTHY R. RAU (NASA, Washington, DC) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 10 p.
(AIAA PAPER 87-2217)

The TMIS goals developed to support the Space Station Program (SSP) mission requirements are outlined. The TMIS will provide common capabilities to all SSP centers and facilitate the flow of technical and management information throughout the program as well as SSP decision-making processes. A summary is presented of the various TMIS phases. K.K.

A87-48605#
EVOLUTION OF DATA MANAGEMENT SYSTEMS FROM SPACELAB TO COLUMBUS
G. BRANDT and H. J. POSPIESZCZYK (MBB-Erno Raumfahrttechnik GmbH, Bremen, West Germany) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 8 p.
(AIAA PAPER 87-2227)

This paper describes the evolution of data management systems, starting with the generic Spacelab design and followed by its utilization during the missions FSLP, D1, and D-2 It describes the Eureca system and finally outlines the Columbus plans. It discusses the experience gained in particular from Spacelab development and mission preparation. An attempt is made to formulate the corresponding Columbus guidelines. Author

A87-49160#
APPLICATION OF PERSONAL COMPUTERS TO REAL-TIME SIMULATION SUPPORT
W. A. RAGSDALE (Unisys Corp., Hampton, VA) IN: AIAA Flight Simulation Technologies Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1987, p. 24-29. refs
(AIAA PAPER 87-2302)

The advent of personal computers (PCs) provides a new cost-effective approach for analysis of simulations. This paper describes some experiences in applying this technology. Specific examples include development of area navigation algorithms, examination of Space Shuttle abort procedures, and vehicle dynamics analysis. Besides the obvious role of PCs as mathematical tools or terminals, it can be beneficial to simplify a large simulation to the level of a 'micro-sim'. The micro-sim can be used to project performance or examine one function of a

system in detail. At the same time, the micro-sim provides a cost-effective flexible training and analysis tool. This paper outlines some of the methods used to produce micro-sims, the results, and limitations of the method. Author

A87-50483*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE USE OF DATABASE MANAGEMENT SYSTEMS AND ARTIFICIAL INTELLIGENCE IN AUTOMATING THE PLANNING OF OPTICAL NAVIGATION PICTURES
ROBERT P. DAVIS and IAN M. UNDERWOOD (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 727-744.
(AIAA PAPER 87-2400)

The use of database management systems (DBMS) and AI to minimize human involvement in the planning of optical navigation pictures for interplanetary space probes is discussed, with application to the Galileo mission. Parameters characterizing the desirability of candidate pictures, and the program generating them, are described. How these parameters automatically build picture records in a database, and the definition of the database structure, are then discussed. The various rules, priorities, and constraints used in selecting pictures are also described. An example is provided of an expert system, written in Prolog, for automatically performing the selection process. R.R.

A87-51723* NASA Scientific and Technical Information Facility, Baltimore/Washington International Airport, Md. 21240.
ONLINE WITH THE WORLD - INTERNATIONAL TELECOMMUNICATIONS CONNECTIONS (AND HOW TO MAKE THEM)
ROBERT F. JACK (NASA, Scientific and Technical Information Facility, Baltimore, MD) Database End-User (ISSN 0882-326X), vol. 2, Sept. 1986, p. 26-29.
(Contract NASW-4070)

The intricacies involved in connecting to online services in Europe are discussed. A sample connection is presented. It is noted that European services usually carry single files on large databases; thus, good searchers can save some money by avoiding backfiles. K.K.

A87-53070#
USED SOFTWARE
R. P. GABRIEL (Lucid, Inc., Menlo Park, CA) IN: AAAIC '86 - Aerospace Applications of Artificial Intelligence; Proceedings of the Second Annual Conference, Dayton, OH, Oct. 14-17, 1986. Volume 1 . Dayton, OH, AAAIC Conference Secretariat, 1986, p. 153-166.

The building of new computer programs out of existing ones, while possible, employs comparatively crude techniques whose expansion by means of new operating systems and hardware is presently considered. A promising way of solving the used software problem is the definition of a common interprogram communications language that can act as a protocol between programs. The interprogram language would need to include abstractions for all of the interchange media available, including such things as characters, strings, lines, textures, etc. This language is not easy to define, and grafting programs together might involve representation changes between programs. O.C.

A87-53071#
DESIGN AUTOMATION SOFTWARE TOOLS - THE RESEARCH STATE OF THE ART
JOHN L. CUADRADO (Octy, Inc., Fairfax Station, VA) IN: AAAIC '86 - Aerospace Applications of Artificial Intelligence; Proceedings of the Second Annual Conference, Dayton, OH, Oct. 14-17, 1986. Volume 1 . Dayton, OH, AAAIC Conference Secretariat, 1986, p. 168-174. refs

This paper presents the major software challenges faced by design automation, and discusses some emerging techniques from artificial intelligence that will help answer these challenges. In particular, the following issues will be examined: the integration of software components and tools, the utilization of graphical programming, the development of efficient man-machine interfaces and sophisticated, second-generation knowledge representation systems. Special attention will be given to the research results of qualitative reasoning and their application in design automation, including numerical data interpretation, device behavior prediction, test generation, simulation, and chip fabrication. Author

A87-53087
FUTURE INFORMATION TECHNOLOGY - THE BIG PICTURE
EDITH W. MARTIN (Boeing Electronics Co., Seattle, WA) IN: The human quest in space; Proceedings of the Twenty-fourth Goddard Memorial Symposium, Greenbelt, MD, Mar. 20, 21, 1986 . San Diego, CA, Univelt, Inc., 1987, p. 145-153; Discussion, p. 154, 155.
(AAS PAPER 86-111)

Future trends in the computer industry are considered. The social and economic changes related to the use of computers are discussed. The advances in component and architecture technology for computer hardware and software are described. It is suggested that there is a need for improvements in computer software, in particular for software capable of system integration. I.F.

N87-11538# Oak Ridge National Lab., Tenn.
ADVANCES IN CONCURRENT COMPUTERS FOR AUTONOMOUS ROBOTS
J. BARHEN, E. C. HALBERT, and J. R. EINSTEIN 1986 32 p Presented at the World Conference on Robotics Research, Scottsdale, Ariz., 19 Aug. 1986
(Contract DE-AC05-84OR-21400)
(DE86-008236; CONF-860841-2) Avail: NTIS HC A03/MF A01

Some of the most challenging computational requirements facing scientists and engineers today arise within the framework of intelligent autonomous systems. To enable robots to work effectively in real time in an unstructured environment, one needs to solve repeatedly a variety of highly complex mathematical problems such as on-line planning, vision, sensor fusion, navigation, manipulator dynamics and control. The computational requirements of most of these problems fall into the supercomputer class, but ultimately one needs to process them onboard the autonomous machine. Currently, the only realistic option is VLSI-based concurrent computation. This paper builds on the recent development of a VLSI hypercube supercomputer, to address the fundamental issue of implementing robotic algorithms on actual concurrent hardware. DOE

N87-12174# Office of Science and Technology, Washington, D.C.
RESEARCH IN VERY HIGH PERFORMANCE COMPUTING: POLICY RECOMMENDATION AND RESEARCH REQUIREMENTS STATEMENT
Nov. 1985 36 p
(PB86-209723) Avail: NTIS HC A03/MF A01 CSCL 09B

The report is concerned with the most powerful computers, generically known as very high performance (VHP) computers. In particular it is concerned with the effects VHP computers will have on the future of the United States. VHP computers include advanced supercomputers used primarily for mathematical modeling, embedded computers used for real-time control, and specialized computers dedicated to a single application such as signal processing. They are used in research, industry, and defense. GRA

N87-13202# California Univ., Berkeley.
AVAILABILITY AND CONSISTENCY OF GLOBAL INFORMATION IN COMPUTER NETWORKS Final Report, 1 Sep. 1983 - 31 Oct. 1985
C. V. RAMAMOORTHY May 1986 212 p
(Contract DAAG29-83-K-0086)
(AD-A169247; ARO-19159.3-EL) Avail: NTIS HC A10/MF A01 CSCL 09B

A principal feature of computer networks is the ability of the various sites of the network to access and update shared information. At the application level, the global information takes the form of shared file systems, databases, etc., and at lower levels, it takes the form of status information used in controlling the network. This research focused techniques for maintaining the availability of global information in the face of various kinds of failures and the consistency of global information in the presence of concurrency. Two failure models were considered: the crash model, in which failures are instantly detected, and the malfunction model, in which an indefinite period of time may lapse before failures are detected. A network status maintenance scheme based on a global clock facility was designed for the crash model. For the malfunction model, an approach to maintaining the correctness of global information and preventing error propagation was developed. Centralized and distributed deadlock detection algorithms were developed for distributed databases.
Author (GRA)

N87-14019# Maryland Univ., College Park. Dept. of Computer Science.
EXPERIMENTATION IN SOFTWARE ENGINEERING
V. R. BASILI, R. W. SELBY, JR., and D. H. HUTCHENS 20 Nov. 1985 38 p
(Contract F49620-80-C-0001)
(AD-A170840; TR-1575; AFOSR-86-0580TR) Avail: NTIS HC A03/MF A01 CSCL 09B

Experimentation in software engineering supports the advancement of the field through an iterative learning process. This paper presents a framework for analyzing most of the experimental work performed in software engineering over the past several years. We describe a variety of experiments in the framework and discuss their contribution to the software engineering discipline. Some useful recommendations for the application of the experimental process in software engineering are included.
Author (GRA)

N87-14201*# National Aeronautics and Space Administration, Washington, D.C.
SPACE RESEARCH DATA MANAGEMENT IN THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
G. H. LUDWIG 1986 96 p
(NASA-TM-89403; NAS 1.15:89403) Avail: NTIS HC A05/MF A01 CSCL 88O

Space related scientific research has passed through a natural evolutionary process. The task of extracting the meaningful information from the raw data is highly involved and will require data processing capabilities that do not exist today. The results are presented of a three year examination of this subject, using an earlier report as a starting point. The general conclusion is that there are areas in which NASA's data management practices can be improved and recommends specific actions. These actions will enhance NASA's ability to extract more of the potential data and to capitalize on future opportunities.
Author

N87-16545# Lawrence Livermore National Lab., Calif.
CONVERTING SCIENTIFIC SOFTWARE TO MULTIPROCESSORS: A CASE STUDY
R. E. STROUT, II 20 Jun. 1986 96 p
(Contract W-7405-ENG-48)
(DE86-014751; UCRL-53751) Avail: NTIS HC A05/MF A01

This paper examines the process and problems involved in converting an application to make use of these machines. A set of FORTRAN routines forming an ordinary differential equation solving software package is used as the subject of the work. A set of explicit primitives for concurrent programming, the Cray multitasking primitives, is used as the method for exploiting concurrency on a Cray X-MP/48 supercomputer. Data analysis is discussed as a useful technique in the conversion, and the tools available within the supercomputing environment are examined for their usefulness in performing the data analysis. Two conversions are performed on the software package. First, to allow multiple problems to execute concurrently, and second, to exploit parallelism within each individual problem. The problems involved in each of these conversions are presented with their considered solutions. Performance measurements are presented for each conversion performed. The data analysis procedure was found too complex and time consuming to perform without appropriate tools. More work than expected was required to produce the first conversion. Finally, the largest source of problems is the lack of sufficient support for multiprocessing from the FORTRAN language. DOE

N87-17529*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
A RESEARCH PROGRAM IN ADVANCED INFORMATION SYSTEMS Final Report
WALLACE E. VANDERVELDE 12 Feb. 1987 22 p
(Contract NAGW-448)
(NASA-CR-180150; NAS 1.26:180150) Avail: NTIS HC A02/MF A01 CSCL 05B

Topics addressed cover: identification of large space structure dynamics; special-purpose architectures for computational fluid dynamics; fault-tolerant processor architectures; data flow techniques; software specification and verification tools; management of software development; software environment for concurrent computing; and parallel algorithms and architectures for the solution of partial differential equations. B.G.

N87-18285# World Climate Programme, Geneva (Switzerland).
CLIMATE COMPUTING (CLICOM) PROJECT (CLIMATE DATA MANAGEMENT SYSTEM)
Jun. 1986 36 p
(WCP-119; WMO/TD-131; ETN-87-98903) Avail: NTIS MF A01; print copy available from WMO, Geneva, Switzerland

The data management systems of the World Climate Data Program Project Transfer of Technology in Climate Data Management and User Services are outlined. The data management module is a microcomputer based climatological data processing system. It provides the capability to digitize, quality control, manage, and analyze climate data. Capabilities to control all other aspects of climate data management as well are included, such as detailed historical information on the locations and observing practices of stations, data dictionary information, and data inventories. ESA

N87-18463# Department of Energy, Washington, D. C.
EPIC/JANUS USER'S GUIDE
30 Jul. 1986 251 p
(DE86-014116; DOE/EIA-0494) Avail: NTIS HC A12/MF A01

EPIC/JANUS, the Energy Information Administration's (EIA) Publication and Interactive Composition System, is a software system which allows text, tables, halftones, and graphics to be combined interactively in a single document. In essence, it automates the entire process of composition and production of camera-ready copy. EPIC is a machine-independent document management and translation system developed by EIA. JANUS is an interactive document composition system which formats and typesets a document. This User's Guide provides complete information on how to use the EPIC/JANUS system. Included in the discussion are sections on getting started, the EPIC system and EIA Standard Text Codes, EPIC interactive commands, graphics in EPIC/JANUS, tables in EPIC/JANUS, EPIC Error messages, MVS and VM listings from EPIC/JANUS, using JANUS interactively, mathematical formula, and producing EPIC/JANUS publications through a displaywriter. Appendices contain a quick reference guide to text codes and text code examples. DOE

N87-18989# Naval Sea Systems Command, Washington, D.C. Office of the Chief Engineer for Logistics.
ENGINEERING MANAGEMENT APPLICATIONS OF COMPUTERS AND DATA PROCESSING
JOYCE DETOLLA and JOSEPH P. DETOLLA 4 Apr. 1986 16 p Presented at the 23rd Annual Technical Symposium, Washington, D.C., 1986
(AD-A174040) Avail: NTIS HC A02/MF A01 CSCL 09B

As computer technology and all that it encompasses have expanded through the years, several areas of specialization have appeared. From a user's viewpoint, some of these specialties are: computer aided design, computer aided manufacturing, computer aided instruction, and document processing systems. Very fundametally, the computer which serves as the basis for these specialties remains the same. The commands given to the computer, the functions it carries out, and the output it provides are tailored to the needs of various user groups. However, specialization has resulted in polarizing of the users. This paper briefly explores areas of computer applications and relates examples which the authors see as obstacles to an integrated ADP system. A survey of computer systems planning and design is presented from the organizational perspective. The paper offers a summary of general issues of software applications, and concludes with views on training as part of the overall computer system implementation process in a large, specialized organization. GRA

N87-19019# National Bureau of Standards, Gaithersburg, Md. Inst. for Computer Sciences and Technology.
EXPERIMENT IN SOFTWARE ACCEPTANCE TESTING
D. R. WALLACE Jul. 1986 20 p
(PB86-247590; NBSIR-86-3407) Avail: NTIS HC A02/MF A01 CSCL 09B

Software acceptance testing was performed on a prototype software engineering environment as part of the program to provide information to Federal agencies for improving quality and productivity in software development and maintenance. The purpose of software acceptance testing is to demonstrate to its purchasers that the software satisfies its requirements. The report describes the method and standards applied in this study in software acceptance testing. The report also discusses the difficulties encountered during the study and proposes research directions for software acceptance testing. GRA

N87-19135# Office of Management and Budget, Washington, D.C.
A FIVE-YEAR PLAN FOR MEETING THE AUTOMATIC DATA PROCESSING AND TELECOMMUNICATIONS NEEDS OF THE FEDERAL GOVERNMENT
Sep. 1986 362 p Prepared in cooperation with General Services Administration, Washington, D.C. and Commerce Dept., Washington, D.C.
Avail: NTIS HC A16/MF A01; also available SOD HC $17.00 as 041-001-00312-6

The fourth Five-Year Automatic Data Processing (ADP) and Telecommunications Plan issued by the Office of Management and Budget (OMB) is given. This year's plan provides information on significant agency information technology initiatives and strategies, descriptions of several major Federal information systems designated for continuing senior management review and a list of all major Federal information systems. The plan also provides Federal managers with information about current trends and issues in the fields of ADP and telecommunications. Author

N87-19921# Strathclyde Univ., Glasgow (Scotland). Dept. of Information Science.
APPLICATIONS IN LIBRARY MANAGEMENT, REQUISITIONS, LOANS AND STOCK CONTROL
PAUL F. BURTON *In* AGARD and The Application of Microcomputers to Aerospace and Defence Scientific and Technical Information Work 5 p Oct. 1986
Avail: NTIS HC A06/MF A01

Applications of the microcomputer in library management, requisitions, loans and stock control are discussed. That the microcomputer has provided numerous libraries and information services (LIS) with an opportunity to automate routines which were previously denied to them because of their size and (usually) their lack of funding, has now achieved the status of a cliche. Plummeting costs of hardware coupled with increasing sophistication and power of software (albeit at increased prices) mean that all but the smallest LIS can now contemplate automation of most routines, including that cluster of applications which is referred to as housekeeping. Indeed, it could be said that these smaller LIS are most able to benefit from computer-based automation, since they are being faced with increasing demands upon their services, demands which have to be met with low (and sometimes reducing) staffing levels. Despite this, the take-up rate of microcomputers has not been high, though there are signs that it is increasing steadily. This can be explained in part by the restrictions of funding which these LIS have faced (in common with all others), but it has to be said that there remains a certain lack of awareness among some LIS managers. Growing number of LIS managers are implementing microcomputers for house-keeping applications, including management tasks, acquisitions, circulation control and aspects of stock management. Author

N87-19923# Logistics Management Inst., Bethesda, Md.
BIBLIOGRAPHIC NETWORKS AND MICROCOMPUTER APPLICATIONS FOR AEROSPACE AND DEFENSE SCIENTIFIC AND TECHNICAL INFORMATION
RICHARD W. HARTT *In* AGARD and The Application of Microcomputers to Aerospace and Defence Scientific and Technical Information Work 16 p Oct. 1986
Avail: NTIS HC A06/MF A01

Bibliographic networks provide the means for sharing information resources among geographically dispersed libraries. As part of a bibliographic network, a single library can access a wide variety of bibliographic information, participate in shared cataloging, and acquire holdings (purchase or loan). Described here are: (1) the functions and operations of libraries supporting aerospace and defense scientific and technical work; (2) the environment and characteristics of bibliographic networks; and (3) the automated system capabilities required for network participation. A discussion of the use of microcomputers as cost-effective, yet powerful tools for exploiting bibliographic network resources is included. An automated system being developed for U.S. Department of Defense technical libraries is described. This system integrates local library functions with capabilities for accessing bibliographic network resources, both government and commercial. Author

N87-19929# Strathclyde Univ., Glasgow (Scotland). Dept. of Information Science.
PROCUREMENT AND MANAGEMENT OF MICROCOMPUTER-BASED SYSTEMS
PAUL F. BURTON *In* AGARD and The Application of Microcomputers to Aerospace and Defence Scientific and Technical Information Work 6 p Oct. 1986
Avail: NTIS HC A06/MF A01

Microcomputer-based systems appear to offer an inexpensive approach to library and information system automation. However, to be effective, efficient and cost-effective, it is still necessary to apply some well-established principles to the specification and procurement of micro-based systems. The procurement process, some of the difficulties associated with micro systems, and the difficulties of finding suitable software are discussed. Once installed, a micro-computer system can provide a number of management

problems, caused, not least, by the inexperience of operators and the direct impact of the systems (as compared with large systems, which are often supported and operated by qualified personnel).
Author

N87-19970# National Bureau of Standards, Gaithersburg, Md. Center for Programming Science and Technology.
MANAGEMENT OVERVIEW OF SOFTWARE REUSE
W. WONG Sep. 1986 27 p
(PB87-109856; NBS/SP-500/142; LC-86-600581) Avail: NTIS HC A03/MF A01; also available SOD HC $1.50 as 003-003-02757-0 CSCL 09B

With skyrocketing software costs, both Federal and private sector organizations are increasingly interested in finding ways to improve software quality and productivity, and reduce software risks. Software reuse is one promising method of accomplishing the objective. The report presents a management overview of the problems and issues related to software reuse. It provides a description of software reusability and its scope. The necessity of technical and management involvement to achieve greater levels of software reuse is emphasized. GRA

N87-19971# National Bureau of Standards, Gaithersburg, Md. Center for Programming Science and Technology.
ANNOTATED BIBLIOGRAPHY ON SOFTWARE MAINTENANCE
W. M. OSBORNE and R. RAIGRODSKI Sep. 1986 142 p
(PB87-109849; NBS/SP-500/141; LC-86-600579) Avail: NTIS HC A07/MF A01; also available SOD HC $6.50 as 003-003-02756-1 CSCL 09B

The annotated bibliography contains summaries of two hundred and eighty-five software maintenance articles or papers from computer science journals, books, proceedings, Federal publications, computer newspapers, and other technical reports. It covers a fifteen year period between 1972 and 1986, and presents an overview of the various aspects of software maintenance including problems and issues faced in most software maintenance environments. It identifies techniques, procedures, methodologies, and tools that have been effectively employed throughout the software system lifecycle to improve the quality of that system.
GRA

N87-19989# University of Southern California, Marina del Rey. Information Sciences Inst.
KNOWLEDGE DELIVERY RESEARCH Final Report
WILLIAM C. MANN Oct. 1986 17 p
(Contract F49620-84-C-0100)
(AD-A174663; ISI/SR-86-178) Avail: NTIS HC A02/MF A01 CSCL 09B

The goal of knowledge delivery research is to create a technology of authorship by computer. Existing technology is all in the laboratory stage, and is limited to very small, rigidly constrained texts. This research project has focused on two kinds of developments: (1) expanding the notation and practices of knowledge representation so that a wider range of knowledge can be rendered in natural language, and (2) creating a theory of text structure that is suitable as a basis for writing programs that design text. GRA

N87-20135# National Bureau of Standards, Washington, D.C. Office of Standard Reference Data.
SCIENTIFIC AND TECHNICAL FACTUAL DATABASES FOR ENERGY RESEARCH AND DEVELOPMENT. CHARACTERISTICS AND STATUS FOR PHYSICS, CHEMISTRY, AND MATERIALS
J. RUMBLE, J. SAUERWEIN, and S. PENNELL Mar. 1986 334 p
(Contract DE-AI05-86TC-40017)
(DE87-001518; DOE/TC-40017/1) Avail: NTIS HC A15/MF A01

A survey of existing factual databases (those containing numbers, graphs, etc.) in physics, chemistry, and materials sciences has been completed. Over 200 databases have been identified of which 175 are available publicly and 50 are either produced or distributed by groups affiliated with the Department of Energy (DOE). A description of characteristics of factual databases is also given as well as recommendation to DOE for further work in this area. DOE

N87-22414# Lawrence Livermore National Lab., Calif.
SUPERCOMPUTER ENVIRONMENTS FOR HARDWARE AND SOFTWARE TECHNOLOGY FORECAST
S. F. MENDICINO, ed. 1987 36 p
(Contract W-7405-ENG-48)
(DE87-007523; UCID-20935) Avail: NTIS HC A03/MF A01

The price-performance revolution in microelectronics and the development of cost-effective communication networks have set the stage for an integrated view of large-scale computing. In the next decade, the supercomputer, the mass storage system, the communication network, and the interactive front ends will be viewed as elements of a total hardware environment whose resources are managed by a single distributed operating system. Since much of the burden of providing effective service in such an environment is placed on software, this report describes not only what potentially lies ahead in the various hardware areas, but also operating systems and related software will evolve over the next decade to complement the hardware. DOE

N87-22423* Computer Software Management and Information Center, Athens, Ga.
COSMIC SOFTWARE CATALOG, 1986 EDITION
1986 417 p Sponsored by NASA
(NASA-CR-176274; NAS 1.26:176274) Avail: Issuing Activity CSCL 09B

This publication contains descriptions of the software supplied by NASA's Computer Software Management and Information Center. Abstracts for 1,108 NASA-sponsored computer programs are included.
Author

N87-22551# General Accounting Office, Washington, D. C.
SPACE OPERATIONS: NASA'S USE OF INFORMATION TECHNOLOGY. REPORT TO THE CHAIRMAN, COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
Apr. 1987 67 p
(GAO/IMTEC-87-20; B-226577) Avail: NTIS HC A04/MF A01

An overview of the information technology that is critical to the missions of NASA are provided. Planning, development, and use of information for three areas (Space Transportation System, space stations, and unmanned space exploration) are discussed.
B.G.

N87-22556# Office of Management and Budget, Washington, D.C.
FIVE-YEAR PLAN FOR MEETING THE AUTOMATIC DATA PROCESSING AND TELECOMMUNICATIONS NEEDS OF THE FEDERAL GOVERNMENT, VOLUME 1 Final Report
Sep. 1986 364 p Prepared in cooperation with General Services Administration, Washington, D.C. and Commerce Dept., Washington, D.C.
(PB87-153326) Avail: NTIS HC A16/MF A01 CSCL 05B

This is Volume 1 of the 1986 five-year plan for meeting the Federal Government's automatic data processing and telecommunications needs. The volume contains an analysis of information technology resource requirements, descriptions of selected information system and significant agency information initiatives. The volume also contains a section of information issues and implications for management. GRA

N87-24121# Oak Ridge National Lab., Tenn.
PROPOSAL FOR CONTINUED RESEARCH IN INTELLIGENT MACHINES AT THE CENTER FOR ENGINEERING SYSTEMS ADVANCED RESEARCH (CESAR) FOR FY 1988 TO FY 1991
C. R. WEISBIN Mar. 1987 143 p
(Contract DE-AC05-84OR-21400)
(DE87-007789; ORNL/TM-10388; CESAR-87/09P) Avail: NTIS HC A07/MF A01

This document reviews research accomplishments achieved by the staff of the Center for Engineering Systems Advanced Research

(CESAR) during the fiscal years 1984 through 1987. The manuscript also describes future CESAR objectives for the 1988-1991 planning horizon, and beyond. As much as possible, the basic research goals are derived from perceived Department of Energy (DOE) needs for increased safety, productivity, and competitiveness in the United States energy producing and consuming facilities. Research areas covered include the HERMIES-II Robot, autonomous robot navigation, hypercube computers, machine vision, and manipulators. DOE

N87-24232# Lawrence Livermore National Lab., Calif.
LIVERMORE RISK ANALYSIS METHODOLOGY: A QUANTITATIVE APPROACH TO MANAGEMENT OF THE RISK ASSOCIATED WITH THE OPERATION OF INFORMATION SYSTEMS
S. B. GUARRO, A. A. GARCIA, C. C. WOOD, and P. G. PRASSINOS 14 Aug. 1986 18 p Presented at the Computer and Communications Security Conference, New York, N.Y., 7 Oct. 1986
(Contract W-7405-ENG-48)
(DE87-006828; UCRL-95133; CONF-8610255-1) Avail: NTIS HC A02/MF A01

Risk assessment methods vary in nature and depth. Their application to the evaluation of information security issues should be decided on the basis of their capability to provide answers to practical and fundamental questions concerning the design and implementation of security controls in specific information systems. Quantitative risk analysis provides an objectively based approach to the problem of assessing and managing risk. As a decision making and risk assessment tool, it is not only capable of identifying potential losses that could be unacceptable for a given system, but it can be used to determine which specific security controls and countermeasures can be effective and cost justifiable. The Livermore Risk Analysis Methodology (LRAM) was developed to cover these objectives in a balanced and comprehensive way. Its model and procedures, from the identification of valuable assets to the prioritization and budgeting of proposed controls, are examined and discussed both from the technical and from the decision making/risk management perspectives. DOE

N87-24233# Oak Ridge National Lab., Tenn.
THE SUCCESS OR FAILURE OF MANAGEMENT INFORMATION SYSTEMS: A THEORETICAL APPROACH
T. R. CURLEE and B. T. TONN Mar. 1987 29 p
(Contract DE-AC05-84OR-21400)
(DE87-007802; ORNL/TM-10320) Avail: NTIS HC A03/MF A01

Work has been done by various disciplines to address the reasons why modern, computerized management information systems either succeed or fail. However, the studies are not based on a well-defined conceptual framework and the focus has been narrow. This report presents a comprehensive conceptual framework of how an information system is used within an organization. This framework not only suggests how the use of an information system may translate into productivity improvements for the implementing organization but also helps to identify why a system may succeed or fail. A major aspect of the model is its distinction between the objectives of the organization in its decision to implement an information system and the objectives of the individual employees who are to use the system. A divergence between these objectives can lead to system under-utilization or misuse at the expense of the organization's overall productivity. DOE

N87-24238# Rutgers - The State Univ., New Brunswick, N. J.
EXPERIMENTS ON THE COGNITIVE ASPECTS OF INFORMATION SEEKING AND INFORMATION RETRIEVING Final Report, 1985-1987
TEFKO SARACEVIC, PAUL KANTOR, ALICE CHAMIS, and DONNA TRIVISON (Case Western Reserve Univ., Cleveland, Ohio.) Jan. 1987 584 p
(Contract NSF IST-87-05411)
(PB87-157699) Avail: NTIS HC A25/MF A01 CSCL 05B

The aim of the study was to contribute to the formal, scientific characterization of the elements involved in information seeking and retrieving, particularly in relation to the cognitive decisions and human interactions involved. The objectives were to conduct experiments and observations under as real-life conditions as possible relative to: user context of questions in information retrieval; the structure and classification of questions; cognitive traits and decision making of searchers; and different searches of the same question. The study involved 40 users with 1 question each, 39 searchers, 360 searchers, and 5411 unique documents evaluated by users. The final report contains detailed descriptions of model, methods, procedures, and results obtained. An appendix contains the raw data, question, and forms used. GRA

N87-25776*# Computer Sciences Corp., Silver Spring, Md.
A SOFTWARE TECHNOLOGY EVALUATION PROGRAM
DAVID N. NOVAES-CARD 0n NASA. Goddard Space Flight Center, Collected Software Engineering Papers, Volume 3 6 p Nov. 1985
Avail: NTIS HC A07/MF A01; single copies available from NASA/GSFC, Code 552, Greenbelt, Md. 20771 CSCL 09B

A set of quantitative approaches is presented for evaluating software development methods and tools. The basic idea is to generate a set of goals which are refined into quantifiable questions which specify metrics to be collected on the software development and maintenance process and product. These metrics can be used to characterize, evaluate, predict, and motivate. They can be used in an active as well as passive way by learning form analyzing the data and improving the methods and tools based upon what is learned from that analysis. Several examples were given representing each of the different approaches to evaluation. The cost of the approaches varied inversely with the level of confidence in the interpretation of the results. Author

N87-25778*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEASURING THE IMPACT OF COMPUTER RESOURCE QUALITY ON THE SOFTWARE DEVELOPMENT PROCESS AND PRODUCT
FRANK MCGARRY, JON VALETT, and DANA HALL (National Aeronautics and Space Administration, Washington, D.C.) *In its* Collected Software Engineering Papers, Volume 3 9 p Nov. 1985
Avail: NTIS HC A07/MF A01; single copies available from NASA/GSFC, Code 552, Greenbelt, Md. 20771 CSCL 09B

The availability and quality of computer resources during the software development process was speculated to have measurable, significant impact on the efficiency of the development process and the quality of the resulting product. Environment components such as the types of tools, machine responsiveness, and quantity of direct access storage may play a major role in the effort to produce the product and in its subsequent quality as measured by factors such as reliability and ease of maintenance. During the past six years, the NASA Goddard Space Flight Center has conducted experiments with software projects in an attempt to better understand the impact of software development methodologies, environments, and general technologies on the software process and product. Data was extracted and examined from nearly 50 software development projects. All were related to support of satellite flight dynamics ground-based computations. The relationship between computer resources and the software development process and product as exemplified by the subject NASA data was examined. Based upon the results, a number of computer resource-related implications are provided. Author

N87-25878# Office of Management and Budget, Washington, D. C.
MANAGING FEDERAL INFORMATION RESOURCES: REPORT UNDER THE PAPERWORK REDUCTION ACT OF 1980 Annual Report No. 5
Apr. 1987 62 p
(PB87-114138) Avail: NTIS HC A04/MF A01 CSCL 05B

The report describes the Office of Management and Budget's progress in managing and overseeing information gathering, processing, and dissemination functions of the Federal government. It includes progress and continuing efforts in strengthening information management within the Federal government, improving Federal statistical programs and reducing information collection burdens imposed upon the public as well as State and local governments. GRA

N87-26682# Dokumentationszentrum der Bundeswehr, Bonn (West Germany).
THE RESOURCES REQUIRED TO RUN AN INFORMATION SERVICE
JAN MUELLER *In* Advisory Group for Aerospace Research and Planning and Designing Effective Defence and Related Information Services 18 p Apr. 1987
Avail: NTIS HC A06/MF A01

Conceptual, manpower, material and financial components are described and discussed as the resources of an information and documentation (I and D) service. The special role of infrastructure is also examined. Author

N87-27547*# Illinois Univ., Urbana. Dept. of Computer Science.
SCHEDULING REAL-TIME, PERIODIC JOBS USING IMPRECISE RESULTS
JANE W. S. LIU, KWEI-JAY LIN, and SWAMINATHAN NATARAJAN 1987 22 p
(Contract NAG1-613)
(NASA-CR-180562; NAS 1.26:180562) Avail: NTIS HC A02/MF A01 CSCL 05A

A process is called a monotone process if the accuracy of its intermediate results is non-decreasing as more time is spent to obtain the result. The result produced by a monotone process upon its normal termination is the desired result; the error in this result is zero. External events such as timeouts or crashes may cause the process to terminate prematurely. If the intermediate result produced by the process upon its premature termination is saved and made available, the application may still find the result unusable and, hence, acceptable; such a result is said to be an imprecise one. The error in an imprecise result is nonzero. The problem of scheduling periodic jobs to meet deadlines on a system that provides the necessary programming language primitives and run-time support for processes to return imprecise results is discussed. This problem differs from the traditional scheduling problems since the scheduler may choose to terminate a task before it is completed, causing it to produce an acceptable but imprecise result. Consequently, the amounts of processor time assigned to tasks in a valid schedule can be less than the amounts of time required to complete the tasks. A meaningful formulation of this problem taking into account the quality of the overall result is discussed. Three algorithms for scheduling jobs for which the effects of errors in results produced in different periods are not cumulative are described, and their relative merits are evaluated. Author

N87-28282# National Bureau of Standards, Gaithersburg, Md. Center for Programming Science and Technology.
REPORT ON THE NBS (NATIONAL BUREAU OF STANDARDS) SOFTWARE ACCEPTANCE TEST WORKSHOP, APRIL 1-2, 1986 Final Report
D. R. WALLACE and J. C. CHERNIAVSKY Mar. 1987 52 p Workshop held at Gaithersburg, Md., 1-2 Apr. 1986
(PB87-179891; NBS/SP-500/146; LC-87-619806) Avail: NTIS HC A04/MF A01 CSCL 09B

The Software Acceptance Test Workshop consisted of eight sessions divided over two days. The topics of the first day's sessions were acceptance testing of off-shelf software, test case selection techniques, automated support for software acceptance testing, and software acceptance criteria. The topics of the second day's sessions were the management of software acceptance testing, standardization issues in software acceptance testing research areas for software acceptance testing, and the state of practice in software acceptance testing. The charges given to all of the sessions, highlights of discussions from each of the sessions, and the conclusions of the workshop are described. GRA

N87-28333*# College of William and Mary, Williamsburg, Va. Dept. of mathematics.
A SOFTWARE TOOLBOX FOR ROBOTICS Final Report
J. C. SANWAL 14 Oct. 1985 10 p
(Contract NAG1-533)
(NASA-CR-181267; NAS 1.26:181267) Avail: NTIS HC A02/MF A01 CSCL 09B

A method for programming cooperating manipulators, which is guided by a geometric description of the task to be performed, is given. For this a suitable language must be used and a method for describing the workplace and the objects in it in geometric terms. A task level command language and its implementation for concurrently driven multiple robot arm is described. The language is suitable for driving a cell in which manipulators, end effectors, and sensors are controlled by their own dedicated processors. These processors can communicate with each other through a communication network. A mechanism for keeping track of the history of the commands already executed allows the command language for the manipulators to be event driven. A frame based world modeling system is utilized to describe the objects in the work environment and any relationships that hold between these objects. This system provides a versatile tool for managing information about the world model. Default actions normally needed are invoked when the data base is updated or accessed. Most of the first level error recovery is also invoked by the database by utilizing the concepts of demons. The package can be utilized to generate task level commands in a problem solver or a planner. Author

N87-28458# Environmental Protection Agency, Washington, D.C. Information Management and Services Div.
BIBLIOGRAPHY ON INFORMATION RESOURCES MANAGEMENT
Nov. 1985 45 p
(PB87-185997; EPA/IMSD-85/003) Avail: NTIS CSCL 05B

The bibliography documents the controversy over the definition of information resources management (IRM) from office automation systems and management information systems to the current user oriented state of the art. It includes citations from 1980, when the Paperwork Reduction Act was passed, to the present. A survey of expert opinion of future developments of IRM is included, as are case studies of IRM as implemented in various organizations. Author

N87-29125*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TOWARDS AS ASSESSMENT OF FAULT-TOLERANT DESIGN PRINCIPLES FOR SOFTWARE
DAVE E. ECKHARDT, JR. *In* NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 1 20 p Aug. 1985
Avail: NTIS HC A16/MF A01 CSCL 09B

Several topics related to the assessment of fault-tolerant design principles for software are presented in outline form. A coincident errors model, discrete intensity distribution and the effects of coincident errors are discussed. R.J.F.

N87-29128*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A WORKSTATION ENVIRONMENT FOR SOFTWARE ENGINEERING
SUSAN J. VOIGT *In* NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 1 11 p Aug. 1985
Avail: NTIS HC A16/MF A01 CSCL 09B

Information on a workstation environment for software engineering is given in outline form. Tools that help software engineers, elements of the present system, and future plans are noted. R.J.F.

N87-29132*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTELLIGENT DATA MANAGEMENT
WILLIAM J. CAMPBELL *In* NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 1 18 p Aug. 1985
Avail: NTIS HC A16/MF A01 CSCL 09B

Intelligent data management is the concept of interfacing a user to a database management system with a value added service that will allow a full range of data management operations at a high level of abstraction using human written language. The development of such a system will be based on expert systems and related artificial intelligence technologies, and will allow the capturing of procedural and relational knowledge about data management operations and the support of a user with such knowledge in an on-line, interactive manner. Such a system will have the following capabilities: (1) the ability to construct a model of the users view of the database, based on the query syntax; (2) the ability to transform English queries and commands into database instructions and processes; (3) the ability to use heuristic knowledge to rapidly prune the data space in search processes; and (4) the ability to use an on-line explanation system to allow the user to understand what the system is doing and why it is doing it. Additional information is given in outline form. Author

N87-29133*# National Aeronautics and Space Administration, Washington, D.C.
SOFTWARE MANAGEMENT ENVIRONMENT FOR NASA
FRANK E. MCGARRY *In its* Proceedings: Computer Science and Data Systems Technical Symposium, Volume 1 26 p Aug. 1985
Avail: NTIS HC A16/MF A01 CSCL 09B

The objective is to develop, access, and implement software management aids, leading to an environment in which software of increased quality can be produced. Viewgraphs on the topic are given. R.J.F.

N87-29143*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SOFTWARE LIFE CYCLE DYNAMIC SIMULATION MODEL: THE ORGANIZATIONAL PERFORMANCE SUBMODEL
ROBERT C. TAUSWORTHE *In* NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 1 25 p Aug. 1985
Avail: NTIS HC A16/MF A01 CSCL 09B

The submodel structure of a software life cycle dynamic simulation model is described. The software process is divided into seven phases, each with product, staff, and funding flows. The model is subdivided into an organizational response submodel, a management submodel, a management influence interface, and a model analyst interface. The concentration here is on the organizational response model, which simulates the performance characteristics of a software development subject to external and internal influences. These influences emanate from two sources: the model analyst interface, which configures the model to simulate the response of an implementing organization subject to its own internal influences, and the management submodel that exerts external dynamic control over the production process. A complete characterization is given of the organizational response submodel in the form of parameterized differential equations governing product, staffing, and funding levels. The parameter values and functions are allocated to the two interfaces. Author

N87-29152*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FIBER OPTIC DATA SYSTEMS
R. HARTENSTEIN *In* NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 11 p Aug. 1985
Avail: NTIS HC A17/MF A01 CSCL 20F

An overview is given of a continuing data system architecture development effort. Accomplishments and states of Office of Aeronautics and Space Technology, NASA efforts are discussed, and possible future directions are briefly commented upon. Some performance data is presented on the access protocol utilized in the Bus Interface Unit (BIU) design effort, and it is compared with other access protocols. The status of the qualification effort is presented showing the successful qualification testing of cables, connectors, light emitting diodes and PIN diodes. Information is given in the form of charts and diagrams. Author

N87-29163*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
USER DATA MANAGEMENT
In NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 9 p Aug. 1985
Avail: NTIS HC A17/MF A01 CSCL 09B

The primary objective is to identify, develop, and demonstrate key data management technologies to support user access to Space Station data. To accomplish this objective, there are several technical challenges which must be addressed. The first is how to provide routine customer access to high volume, dynamic and distributed data bases. This access will encompass the functions of mission and payload planning and operations, data processing and analysis, and data archive and distribution. Secondly, there must be some analysis of architectures for handling high volume data streams like those expected from the Space Station. This analysis will examine the use of packetized versus non-packetized data formats, modular expansion capabilities, real-time versus non-real-time data processing, and the interfaces and architecture required to support telescience operations. The task will also determine benchmarks of performance capabilities for technology operations, such as varied data base structures, data access procedures, distributed data base design, and data base machines. Information is provided here in outline form. Author

N87-29164*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ADVANCED SOFTWARE TOOLS SPACE STATION FOCUSED TECHNOLOGY
ROBERT W. NELSON *In* NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 11 p Aug. 1985
Avail: NTIS HC A17/MF A01 CSCL 09B

Information is given in outline form on advanced software tools for the Space Station data management system. The Space Station data management system is identified as a highly distributed system with payload users controlling experiments and processing payload data from home facilities. R.J.F.

N87-29171# California Univ., Los Angeles. Western Management Science Inst.
COMPARATIVE ANALYSIS OF MATHEMATICAL PROGRAMMING SYSTEMS
SERGIO V. MATURANA May 1987 45 p Presented at the TIMS/ORSA Meeting, New Orleans, La., May 1987
(AD-A182485; WMSC-WP-347) Avail: NTIS HC A03/MF A01 CSCL 09B

There is a growing number of mathematical programming systems that try to offer a simpler way for solving complex problems, using the computer, than the traditional approach. This paper undertakes a comparative analysis of some of these systems and identifies the main issues involved in designing and implementing such systems. GRA

N87-29530*# IBM Federal Systems Div., Houston, Texas.
THE DEVELOPMENT PROCESS FOR THE SPACE SHUTTLE PRIMARY AVIONICS SOFTWARE SYSTEM
T. W. KELLER 1987 87 p Prepared for presentation at the Common Conference, Chicago, Ill., 20 Oct. 1987
(Contract NAS9-16920)
(NASA-CR-180425; NAS 1.26:180425) Avail: NTIS HC A05/MF A01 CSCL 01D

Primary avionics software system; software development approach; user support and problem diagnosis; software releases and configuration; quality/productivity programs; and software development/production facilities are addressed. Also examined are the external evaluations of the IBM process. B.G.

N87-30082# Carnegie-Mellon Univ., Pittsburgh, Pa. Software Engineering Inst.
CHARACTERIZING THE SOFTWARE PROCESS: A MATURITY FRAMEWORK Final Report
WATTS S. HUMPHREY Jun. 1987 16 p
(Contract F19628-85-C-0003)
(AD-A182895; CMU/SEI-87-TR-11; ESD-TR-87-112) Avail: NTIS HC A02/MF A01 CSCL 09B

Improvement in the performance of software development organizations is an essential national need. The improvement process has five basic elements: (1) an understanding of the current status of the development process, (2) a vision of the desired process, (3) a prioritized list of required improvements actions, (4) a plan to accomplish these actions and (5) the resources andcommittment to execute the plan. This paper addresses the first three of these elements, by providing a model for software organizational improvement. The structure of this model provides five maturity levels, identifies the key improvements required at each level, and establishes a priority order for implementation. This model has been tested with a number of organizations and represented reasonably the status and needs of actual software development groups. GRA

N87-30090# Carnegie-Mellon Univ., Pittsburgh, Pa. Software Engineering Inst.
PRELIMINARY REPORT ON CONDUCTING SEI-ASSISTED ASSESSMENTS OF SOFTWARE ENGINEERING CAPABILITY Final Report
WATTS S. HUMPHREY and DAVID H. KITSON Jul. 1987 37 p
(Contract F19628-85-C-0003)
(AD-A183429; CMU/SEI-87-TR-16; ESD-TR-87-117) Avail: NTIS HC A03/MF A01 CSCL 12E

Characterizing the state of software engineering practice within an organization is a necessary prerequisite to orderly, meaningful, and sustainable improvement of the organization's ability to produce or support cost-effective, high quality software products. The Software Engineering Institute (SEI) is developing a methodology for conducting SEI-assisted assessments of software engineering capability. The assessment methodology has five phases: (1) selecting the candidate organization, (2) preparing for the assessment, (3) conducting the assessment, (4) communicating final assessment findings and action recommendations, and (5) post-assessment followup activities. This report describes the methodology in detail. Author (GRA)

06

RESEARCH AND DEVELOPMENT

Includes Contracts and Contract Management, Project Management, Program Management, Research Projects and Research Facilities, Scientific Research, Innovations and Inventions, Technology Transfer and Utilization, R & D Resources, Agency, National and International R & D.

A87-10026
SPACE CONGRESS, 23RD, COCOA BEACH, FL, APRIL 22-25, 1986, PROCEEDINGS
Congress sponsored by the Canaveral Council of Technical Societies. Cape Canaveral, FL, Canaveral Council of Technical Societies, 1986, 469 p. For individual items see A87-10027 to A87-10053.

Papers concerned with developing space for tomorrow's society are presented. Consideration is given to international space activities, the use of computers in space, low-cost Shuttle payloads, streamling ground operations, and the commercialization of space. Topics discussed include contracts and management, Space Station technology, the effects of satellites on daily activities, second generation space transportation systems and launch vehicles technology, and the use of robotics and AI in aerospace operations. I.F.

A87-10043* National Aeronautics and Space Administration, Washington, D.C.
TECHNICAL ASPECTS OF THE UNITED STATES SPACE STATION
D. H. HERMAN (NASA, Washington, DC) and D. BRIEHL IN: Space Congress, 23rd, Cocoa Beach, FL, April 22-25, 1986, Proceedings . Cape Canaveral, FL, Canaveral Council of Technical Societies, 1986, p. 7-1 to 7-6.

The design and development of the Space Station are described. The proposed design of the Station is a dual keel configuration which will include manned facilities and unmanned free flying platforms. The Station is to be utilized as a space-based laboratory for basic research and observations, a depot for repair and servicing of spacecraft, a strorage area, and a manufacturing facility. International participation in the Space Station program and technological developments applicable for the Station are discussed. A diagram of the Space Station configuration and a Space Station development schedule are provided. I.F.

A87-10052* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
GOVERNMENT CONCEPTUAL ESTIMATING FOR CONTRACTING AND MANAGEMENT
J. A. BROWN (NASA, Kennedy Space Center, Cocoa Beach, FL) IN: Space Congress, 23rd, Cocoa Beach, FL, April 22-25, 1986, Proceedings . Cape Canaveral, FL, Canaveral Council of Technical Societies, 1986, p. 11-9 to 11-16. refs

The use of the Aerospace Price Book, a cost index, and conceptual cost estimating for cost-effective design and construction of space facilities is discussed. The price book consists of over 200 commonly used conceptual elements and 100 systems summaries of projects such as launch pads, processing facilities, and air locks. The cost index is composed of three divisions: (1) bid summaries of major Shuttle projects, (2) budget cost data sheets, and (3) cost management summaries; each of these divisions is described. Conceptual estimates of facilities and ground support equipment are required to provide the most probable project cost for budget, funding, and project approval purposes. Similar buildings, systems, and elements already designed are located in the cost index in order to make the best rough order of magnitude conceptual estimates for development of Space Shuttle facilities. An example displaying the applicability of the conceptual cost estimating procedure for the development of the KSC facilities is presented. Author

A87-10547
MATERIALS RESEARCH IN SPACE - EXPERIMENTAL TOOL OR PRODUCTION BASE?
B. DERBY (Oxford University, England) British Interplanetary Society, Journal (Space Technology) (ISSN 0007-084X), vol. 39, Aug. 1986, p. 362-365. refs

Due to the relatively high gravity field and vibrations that will be experienced on the Space Station (SS), a platform serviced from the SS and nominally in a higher orbit will probably be used for space-based materials processing. However, orbits high enough to provide gravity of about 1/10 millionth g cause second-order effects such as Marangoni convection, segregation, repulsion of particles by an advancing solid interface, etc., which have been observed in Spacelab to dominate. Crystal growth is a particularly appealing candidate for space materials production. Also, perfect spheres, useful as standards on earth, may be manufactured in space because liquids in microgravity tend to their lowest energy configuration, i.e., spheres. Finally, electrophoresis-produced pharmaceuticals and single crystals which are unstable at high temperatures may also be grown in space. The main characteristic of the first commercial products will be a high value per mass. M.S.K.

A87-10801
COMMERCIALIZATION OF TECHNOLOGY - CONSIDERATIONS FOR SUCCESSFUL TRANSFER
G. J. POSAKONY (Battelle Pacific Northwest Laboratories, Richland, WA) IN: Review of progress in quantitative nondestructive evaluation. Volume 5B - Proceedings of the Twelfth Annual Review, Williamsburg, VA, June 23-28, 1985 . New York, Plenum Press, 1986, p. 1735-1738.

The transfer and commercialization of technology are studied. The use of market analyses and business plans by the company that developed the technology (holder) and the company receiving it (receiver) are required for effective technology transfer. The exchange of personnel between the holding and receiving companies is discussed. The promotion and acceptance of the technology are considered. I.F.

A87-10875* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE INDUSTRIALIZATION OPPORTUNITIES
C. M. JERNIGAN, ED. (NASA, Marshall Space Flight Center, Huntsville, AL) and E. PENTECOST, ED. (NASA, Washington, DC) Park Ridge, NJ, Noyes Publications, 1985, 624 p. No individual items are abstracted in this volume.

The current status of efforts to develop commercial space projects is surveyed, with a focus on US programs, in reviews and reports presented at the Second Symposium on Space Industrialization held in Huntsville in February 1984. Areas explored include policy, legal, and economic aspects; communications; materials processing; earth-resources observation; and the role of space carriers and a space station. Also included in the volume are 132 brief descriptions of the NASA Microgravity Science and Applications Program Tasks as of December 1984. These tasks cover the fields electronics materials; solidification of metals, alloys, and composites; fields and transport phenomena; biotechnology; glass and ceramics; combustion science; and experimental technology. T.K.

A87-13716* Virginia Univ., Charlottesville.
VISUAL MONITORING OF AUTONOMOUS LIFE SCIENCES EXPERIMENTATION
G. E. BLANK and W. N. MARTIN (Virginia, University, Charlottesville) IN: Space station automation; Proceedings of the Meeting, Cambridge, MA, September 17, 18, 1985 . Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1985, p. 88-94. refs
(Contract NAG5-597; NSF ECS-83-07248)

The goal of this research project is the development of a computer vision system to monitor and control life sciences experimentation on board space stations. The vision system is organized as a multiprocessor system with distributed processes selectively analyzing hierarchical imagery in order to monitor and control the appropriate instrumentation. Author

A87-13948
OVERCOMING HURDLES
J. K. MANBER Commercial Space (ISSN 8756-4831), vol. 2, Summer 1986, p. 46, 47; 49-51.

Consideration is given to the accomplishments of the 3M Company, the first nonaerospace firm to establish a space research laboratory. The sequence of events leading to the 3M-NASA relationship is outlined in an attempt to demonstrate how fruitful and cost-effective this joint effort has been. Thus far, the company has conducted three Shuttle research experiments with 21 samples of organic crystals including urea, copper phthalocyanine, and dicarboximide. Owing to these initial experiments, the company has filed patents relating to Shuttle hardware and crystal growth. In light of the temporary grounding of the Shuttle program, 3M has suggested the following recommendations for the American corporation: (1) the use of the Shuttle must be for ongoing research, (2) the organization must be supported by a culture that understands the long-term nature of basic research, and (3) the organization should be willing to consider joint research in space. K.K.

A87-14058#
TETHERED PLATFORMS - NEW FACILITIES FOR SCIENTIFIC AND APPLIED RESEARCH IN SPACE
F. BEVILACQUA, P. MERLINA, and A. ANSELMI (Aeritalia S.p.A., Gruppo Sistemi Spaziali ed Energie Alternative, Turin, Italy) NASA, AIAA, and PSN, International Conference on Tethers in Space, Arlington, VA, Sept. 17-19, 1986, Paper. 18 p. refs

Issues related to the use of tethered platforms to support Space Station operations and experiments are considered. The platform is analyzed in terms of flexibility, serviceability, compatibility, and orbit, and the lifetime of the tether is evaluated based on tether diameter and length. The requirements and operation of the Space Elevator designed for transport of materials between the platform and Space Station are described. I.F.

A87-14375
GETTING BACK ON TRACK IN SPACE
R. A. LEWIS (Arizona, University, Tucson) and J. S. LEWIS Technology Review (ISSN 0040-1692), vol. 89, Aug.-Sept. 1986, p. 30-40.

The history, current status, and future of the US space program are examined critically from a science perspective. Topics discussed include the early Soviet lead in heavy boosters, the success of the Apollo program, the lack of an Apollo follow-up program, economic and political factors affecting the decision to concentrate NASA efforts on the Space Shuttle (STS), the abandonment of the Saturn boosters and Skylab, the increasing costs of STS, concomitant decreases in overall NASA funding, military demands on STS, and the slow but continuing progress of the Soviet space program. It is argued that space science objectives would have been and will be better served by a diversified program of mainly unmanned missions than by all-purpose (commercial/military/science) programs such as STS and the proposed Space Station. Recommendations for the future include a long-term program to establish a permanent manned station on Mars, reinvestigation of a solar-power-satellite system, transfer of STS operations to an independent agency, longer-term funding of NASA R&D programs by Congress, competitive development of a new lower-cast heavy-lift launcher, more use of military rockets, and international cooperation on large-scale undertakings. T.K.

A87-15378
LOOKING AHEAD FIFTY YEARS IN SPACE
T. O. PAINE (Thomas Paine Associates, Los Angeles, CA) IN: Space Station beyond IOC; Proceedings of the Thirty-second Annual International Conference, Los Angeles, CA, November 6, 7, 1985 . San Diego, CA, Univelt, Inc., 1986, p. 23-29.
(AAS PAPER 85-453)

A short summary is presented of goals identified by the U.S. National Commission on Space up to 2135, along with desirable missions until 2005. The primary need identified is more routine, cheaper access to space, the latter being a figure of $200 per lb to LEO. A space industrial park is envisioned, initially for testing, development and application of remote sensing instruments. A Space Station in LEO is regarded as a necessary spaceport for transfer orbits to GEO and to more distant goals in the solar system. Other spaceports are needed at a libration point, in a polar lunar orbit and around Mars. M.S.K.

A87-15387* National Aeronautics and Space Administration, Washington, D.C.
THE PLANETARY EXPLORATION PROGRAM - A PREVIEW OF PLANS FOR THE 21ST CENTURY
J. D. ROSENDHAL (NASA, Office of Space Science and Applications, Washington, DC) IN: Space Station beyond IOC; Proceedings of the Thirty-second Annual International Conference, Los Angeles, CA, November 6, 7, 1985 . San Diego, CA, Univelt, Inc., 1986, p. 111-116.
(AAS PAPER 85-477)

Interplanetary missions which may be pursued in the late 20th and early 21st centuries are discussed, with emphasis on possible roles for the Space Station in the IOC and in growth configurations. The Station could serve as an assembly, fueling and tracking base for interplanetary missions, first unmanned and then manned. M.S.K.

A87-15390
INTERNATIONAL COOPERATION IN THE SPACE STATION ERA
T. H. USSHER (Spar Aerospace, Ltd., Remote Manipulator Systems Div., Weston, Canada) IN: Space Station beyond IOC; Proceedings of the Thirty-second Annual International Conference, Los Angeles, CA, November 6, 7, 1985 . San Diego, CA, Univelt, Inc., 1986, p. 153-159.
(AAS PAPER 85-488)

Various ways in which the Space Station will be an international effort are discussed, with an emphasis on Canadian participation in the program. Prime reasons nations are joining the program include technology exchanges, a refinement of management procedures, expansion of the knowledge base and the creation of jobs. Canada, developer of the RMS, is designing an Integrated Servicing and Test Facility, building on the experience with robotics, and pushing the bounds of expert systems and AI. M.S.K.

A87-15451* Florida State Univ., Tallahassee.
RECENT ADVANCES IN AERODYNAMICS
A. KROTHAPALLI, ED. (Florida State University, Tallahassee) and C. A. SMITH, ED. (NASA, Ames Research Center, Moffett Field, CA) New York, Springer-Verlag, 1986, 767 p. For individual items see A87-15452 to A87-15469.

Papers are presented on unsteady transonic aerodynamics and aeroelasticity, the unsteady separation phenomenon, and a wind tunnel method for V/STOL testing. Also considered are vortex-edge interactions, jet instability theory, large-scale organized motions in jets and shear layers, and the evolution of adaptive-wall wind tunnels. Other topics include advances in ejector thrust augmentation, multiple jet impingement flowfields, and recent advances in prediction methods for jet-induced effects on V/STOL aircraft. R.R.

A87-15715#
A PAYLOAD SUPPORT SYSTEM FOR EXPERIMENTS USING THE NASA GET AWAY SPECIAL
J. THURBER and G. WILSON (USAF, Geophysics Laboratory, Bedford, MA) IN: Conference on Sounding Rockets, Balloons and Related Space Systems, 7th, Ocean City, MD, October 28-30, 1986, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1986, p. 98-101.
(AIAA PAPER 86-2539)

AFGL has designed a payload support system for use with the NASA Getaway Special. The AFGL system provides cost-effective support for experiments requiring flexible control, data storage, and prolonged exposure in space. This paper presents a brief description of the payload support system, including system operations and user options. Estimated cost using the AFGL system is presented. And finally, operations involving an actual payload are discussed. Author

A87-15839*# National Aeronautics and Space Administration, Washington, D.C.
APPLICATION OF ADVANCED TECHNOLOGY TO A PERMANENTLY MANNED SPACE STATION
R. F. CARLISLE (NASA, Office of Space Station, Washington, DC) and M. NOLAN (NASA, Johnson Space Center, Houston, TX) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 12 p.
(IAF PAPER 86-60)

Advanced technologies developed by NASA's Space Station Advanced Development Program (ADP), which cover some 70 application areas, are discussed. Current data are presented that show promising applications in four of these areas: the Environmental Control and Life Support, Extravehicular Activities, Electrical Power, and Thermal Subsystem Design. I.S.

A87-15870*# National Aeronautics and Space Administration, Washington, D.C.
POTENTIAL DIRECTIONS FOR A SECOND GENERATION SPACE SHUTTLE
I. BEKEY (NASA, Office of Space Flight, Washington, DC) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 7 p.
(IAF PAPER 86-106)

This paper reports on trends and potentials for advanced rocket vehicles which may be candidates for eventual phased replacement of the Shuttle. Although such a replacement need is not foreseen until 2002 at the earliest, due to the long time to develop a new vehicle its definition has already begun. The paper discusses the role of such a 'Shuttle II' in the architecture of launch vehicles likely to exist in the post-2000 era, leading to its designation as a smaller, primarily passenger-carrying vehicle to complement large, unmanned cargo launch vehicles. While a two-stage glide-back fully reusable configuration is optimum for near-term technology, a single-stage-to-orbit reusable glide-back configuration is optimum for farther-term technology advances. For advanced technology which could be available in the mid-90s, such vehicle could orbit a payload weight equal to their own dry weight - a factor of 10 better than current launch vehicles. Author

A87-16015*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE MARS OBSERVER MISSION
W. I. PURDY, JR. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) and A. L. ALBEE (California Institute of Technology, Pasadena) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 9 p. NASA-supported research. refs
(IAF PAPER 86-318)

Attention is given to the establishment of the Planetary Observer program and the initiation of the Mars Observer project (scheduled for 1990), its scientific objectives, and plans for operations. The Mars Observer mission will provide a spacecraft platform about Mars from which the entire Martian surface and atmosphere may be mapped for at least one Martian year. This first Planetary

Observer mission will reveal how a series of low-cost missions can be planned and implemented to fit within constrained NASA budget for planetary operation. K.K.

A87-16031*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MOBILE SATELLITE COMMUNICATIONS TECHNOLOGY - A SUMMARY OF NASA ACTIVITIES
E. J. DUTZI (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) and G. H. KNOUSE (NASA, Washington, DC) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 16 p. NASA-supported research. refs
(IAF PAPER 86-337)

Studies in recent years indicate that future high-capacity mobile satellite systems are viable only if certain high-risk enabling technologies are developed. Accordingly, NASA has structured an advanced technology development program aimed at efficient utilization of orbit, spectrum, and power. Over the last two years, studies have concentrated on developing concepts and identifying cost drivers and other issues associated with the major technical areas of emphasis: vehicle antennas, speech compression, bandwidth-efficient digital modems, network architecture, mobile satellite channel characterization, and selected space segment technology. The program is now entering the next phase - breadboarding, development, and field experimentation. Author

A87-16095#
FORMATION OF A SPACE RESEARCH PROGRAM WITH THE USE OF ECONOMIC CRITERIA
V. N. NOVIKOV and D. N. SHEVEROV (AN SSSR, Moscow, USSR) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 19 p. refs
(IAF PAPER 86-441)

An economic approach to determining an optimal space research program is outlined. The formulation of such an approach based on complex iterative dynamic methods and on logical models is discussed. It is concluded that complex iterative dynamic approaches are the best for obtaining quantitative information for a space research program, and that for comparing research and development plans, a model which takes reliability, time, volume of measures, and costs into account is desirable. The development of a space vehicle cargo delivery is addressed as an example. C.D.

A87-16096*# National Aeronautics and Space Administration, Washington, D.C.
TECHNOLOGIES FOR AFFORDABLE ACCESS TO SPACE
R. S. COLLADAY and S. R. SADIN (NASA, Washington, DC) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 8 p.
(IAF PAPER 86-442)

NASA plans for advanced research and technology programs aimed at reducing operating costs and extending the capability of future space systems are described. The evolution of an almost entirely space-based mode is discussed, including the role of earth launch, servicing, fabrication and assembly and communications. The development of technology for affordable access to space is examined, taking into account progress in the areas of telerobotics, machine autonomy, human autonomy, space-based manufacturing and construction, electric power, and space-based propulsion. C.D.

A87-16097*# National Aeronautics and Space Administration, Washington, D.C.
TOWARDS INDUSTRIAL DEVELOPMENT IN SPACE
I. T. GILLAM, IV (NASA, Washington, DC) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 9 p.
(IAF PAPER 86-444)

NASA's role in the industrial and commercial development of space is examined. The objectives of the Office of Commercial Programs are discussed. The technology dissemination and technology applications of the Technology Utilization Program are described; examples of successful technology transfers such as the programmable implantable medication system, automatic implantable defibrillation, and the ultrasonic residual stress monitor are provided. Future goals of this program are considered. The Center for Commercial Development of Space program is designed to stimulate space-related research which will produce new products with commercial applications. Examples of NASA-supported R&D projects are presented. I.F.

A87-16110*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SPACE STATION DESIGN FOR GROWTH
E. B. PRITCHARD (NASA, Langley Research Center, Hampton, VA) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 9 p.
(IAF PAPER 86-461)

This paper reviews the current status of Space Station planning for growth as the basis of an assessment of potential Space Station evolution directions in the 21st Century to meet the challenges of the report of the U.S. National Commission on space, 'Pioneering the Space Frontier'. Thus future mission requirements are reviewed and assessed. Based on these requirements, evolution scenarios and potential configurations are developed. It is concluded that the Space Station, as a multipurpose facility, should evolve to a capability of 300 kW, crew of 18 and 5 lab modules. Beyond this capability it will be necessary to separate functions and establish two separate Space Stations, one for research and one for operational activities (e.g., transportation node, servicing, etc.). If the U.S. National Commission on space's recommendations are adopted, this separation or 'branching' could occur as early as 2005 to meet the needs of a permanent lunar base. Author

A87-16399
SPACE STATION - NASA'S GREATEST CHALLENGE
T. FURNISS Flight International (ISSN 0015-3710), vol. 130, Aug. 30, 1986, p. 137-140.

An account is given of the progress made by NASA on a Space Station; attention is given to the apportionment of development tasks among NASA facilities and foreign participants in this international project. When completed, the NASA Space Station will encompass four manned modules, of which two will be from the U.S., one from Europe, and the last from Japan. For the first time in any U.S. manned spacecraft, there will be a closed loop environmental control and life support system. O.C.

A87-16762* Lockheed-Georgia Co., Marietta.
A NEW MEANING TO 'FLYING THE DESK'
G. A. SEXTON (Lockheed-Georgia Co., Marietta, GA) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1986, p. 360-366.
(Contract NAS1-16199)

A unique advanced transport flight station design is described. The various systems and displays of the design are described, including: the configuration; switches; tailored logic/artificial intelligence; primary flight controllers; front panel displays; primary flight/navigation display; engine power/status, approach charts, and weather display; the Advisory, Caution, and Warning System/Cockpit Display of Traffic Information display; checklist/functional systems display; head-up display; voice command and response system; Flight Management Computer system; and integrated communications/navigation system. The application of the flight station to military research is briefly discussed. C.D.

A87-17142#
NATIONAL AERO-SPACE PLANE - TECHNOLOGY FOR AMERICA'S FUTURE
R. M. WILLIAMS (DARPA, Arlington, VA) Aerospace America (ISSN 0740-722X), vol. 24, Nov. 1986, p. 18-22.

The objectives of the National Aero-Space Plane (NASP) program are discussed. The NASP program is to develop and test the technologies necessary for the development of military and civil vehicles capable of operating at sustained hypersonic speeds within the atmosphere and/or operating as space launch vehicles for delivering payloads into orbit. Technologies being developed include: air-breathing propulsion and engine components; high-strength, high-temperature, light-weight, fully reusable materials; structural and propulsion design codes; high-efficiency energy management of the hydrogen fuel; and advanced computer and adaptive-intelligence control systems. I.F.

A87-17944*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRCRAFT RESEARCH AND DEVELOPMENT TRENDS IN THE US AND USSR
M. L. SPEARMAN (NASA, Langley Research Center, Hampton, VA) AIAA, AHS, and ASEE, Aircraft Systems, Design and Technology Meeting, Dayton, OH, Oct. 20-22, 1986. 14 p. refs (AIAA PAPER 86-2720)

Research and development related to aircraft has shown significant progress in both the U.S. and the USSR. In some cases, the indications are that technological advances have resulted in new aircraft concepts and, in other cases, there are indications of particular national needs or objectives that have driven the required research and development to meet the need. The progression of aircraft development tends to reflect factors other than technology such as the political atmosphere, the world environment, and other contending national objectives. The trends in aircraft research and development in the U.S. and USSR will be traced from the early 1900's and, in a time-frame manner, will be related to other influencing factors. Author

A87-18202* National Aeronautics and Space Administration, Washington, D.C.
NEW DIRECTIONS IN THE NASA PROGRAM
U. J. SAKSS and H. J. CLARK (NASA, Washington, DC) IN: International Symposium on Space Technology and Science, 14th, Tokyo, Japan, May 27-June 1, 1984, Proceedings . Tokyo, AGNE Publishing, Inc., 1984, p. 3-8.

This paper reports on the current activities of the U.S. National Aeronautics and Space Administration (NASA), and discusses several new directions in NASA's program. The Space Transportation System (STS) is operational and is now performing a wide variety of missions, including repair of spacecraft on orbit. A family of upper stages are available for missions requiring higher energy than the Shuttle alone can provide. With routine access to space assured by the STS, the U.S. is ready to take its next logical step into space with development of a permanently manned Space Station. In addition, NASA is supporting a program for increased commercial development of space through a government-industry partnership. Author

A87-18203
ESA ON-GOING PROGRAMMES AND FUTURE PROSPECTS
R. MORY (ESA, Directorate of Space Transportation Systems, Paris, France) IN: International Symposium on Space Technology and Science, 14th, Tokyo, Japan, May 27-June 1, 1984, Proceedings . Tokyo, AGNE Publishing, Inc., 1984, p. 9-15.

The current status of ESA space programs is surveyed. Consideration is given to space-science satellites and probes; microgravity projects; terrestrial remote sensing with Meteosat, Earthnet, and ERS-1; telecommunications satellites; the Ariane, Spacelab, and Eureca space transportation systems; and long-term plans for launcher, in-orbit-infrastructure, and manned-space-station development (in cooperation with NASA). T.K.

A87-18339
SCIENTISTS IN SPACE - THE EUROPEAN EXPERIENCE WITH SPACELAB MISSION ONE
O. A. CHIARENZA and D. D. FRIMOUT (ESA, Space Transportation Systems Directorate, Paris, France) IN: International Symposium on Space Technology and Science, 14th, Tokyo, Japan, May 27-June 1, 1984, Proceedings . Tokyo, AGNE Publishing, Inc., 1984, p. 1079-1085.

The European payload and science crew aboard the Spacelab Mission One are described. The main objectives of the European Spacelab Mission One experiments are mentioned, as are the different tasks of the individual members of the European crew. The main scientific achievements of the first Spacelab flight are summarized. C.D.

A87-18350
EUROPEAN RETRIEVABLE CARRIER - A NEW OPPORTUNITY FOR MICROGRAVITY RESEARCH, SPACE TECHNOLOGY DEVELOPMENT AND SCIENCE APPLICATIONS
R. MORY (ESA, Space Transportation Systems Directorate, Paris, France) IN: International Symposium on Space Technology and Science, 14th, Tokyo, Japan, May 27-June 1, 1984, Proceedings . Tokyo, AGNE Publishing, Inc., 1984, p. 1163-1172.

A87-18870
LAUNCHERS - THE FIRST 50-YEAR CYCLE
G. K. C. PARDOE (General Technology Systems, Ltd., London, England) Space (ISSN 0267-954X), vol. 2, Sept.-Nov. 1986, p. 52, 53, 57.

An assessment is made of the development history of spacecraft launch vehicles to the present date, with attention to mission economics and the criteria of profitability. Three technological generations are postulated: that dominated by expendable launch vehicles, lasting from 1957 to the introduction of the Space Shuttle; the Space Shuttle period of semireusable launch vehicles; and the soon-to-be-inaugurated era of fully reusable launchers which are expected to begin operations around the year 2000. O.C.

A87-19066* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
CARDIOVASCULAR RESEARCH IN SPACE - CONSIDERATIONS FOR THE DESIGN OF THE HUMAN RESEARCH FACILITY OF THE UNITED STATES SPACE STATION
J. B. CHARLES and M. W. BUNGO (NASA, Johnson Space Center, Houston, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 57, Oct. 1986, p. 1000-1005. refs

The design of the Space Station's Human Research Facility for the collection of information on the long-time physiological adjustments of humans to space is described. The Space Life Sciences-1 mission will carry a rack-mounted echocardiograph for cardiac imaging, a mass spectrometer for cardiac output and respiratory function assessments at rest and during exercise, and a device to stimulate the carotid sinus baroreceptors and measure the resulting changes in heart rate. I.S.

A87-20358* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
JOINING TECHNOLOGIES FOR THE 1990S: WELDING, BRAZING, SOLDERING, MECHANICAL, EXPLOSIVE, SOLID-STATE, ADHESIVE
JOHN D. BUCKLEY, ED. and BLAND A. STEIN, ED. (NASA, Langley Research Center, Hampton, VA) Park Ridge, NJ, Noyes Data Corp., 1986, 497 p. Previously announced in STAR as N86-11227; No individual items are abstracted in this volume.

A compilation of papers presented in a joint NASA, American Society for Metals, The George Washington University, American Welding Society, and Society of Manufacturing Engineers Conference on Welding, Bonding, and Fastening at Langley Research Center, Hampton, VA, on October 23 to 25, 1984 is given. Papers were presented on technology developed in current research programs relevant to welding, bonding, and fastening of structural materials required in fabricating structures and

mechanical systems used in the aerospace, hydrospace, and automotive industries. Topics covered in the conference included equipment, hardware and materials used when welding, brazing, and soldering, mechanical fastening, explosive welding, use of unique selected joining techniques, adhesives bonding, and nondestructive evaluation. A concept of the factory of the future was presented, followed by advanced welding techniques, automated equipment for welding, welding in a cryogenic atmosphere, blind fastening, stress corrosion resistant fasteners, fastening equipment, explosive welding of different configurations and materials, solid-state bonding, electron beam welding, new adhesives, effects of cryogenics on adhesives, and new techniques and equipment for adhesive bonding. NASA

A87-20678* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MORE MISSIONS TO EXPLORE THE SOLAR SYSTEM
J. R. FRENCH (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) Spaceflight (ISSN 0038-6340), vol. 28, May 1986, p. 207-210. NASA-supported research.

Various JPL space missions are discussed. Consideration is given to the objectives and capabilities of the Hubble Telescope, the SIR-B, the Magellan spacecraft, and the Mars Observer missions. The planned Topex and Comet Rendezvous Asteroid Flyby mission are described. The development of an autonomous surface roving vehicle to collect samples on Mars is proposed. I.F.

A87-20679
ON WINGS INTO SPACE
CURTIS PEEBLES Spaceflight (ISSN 0038-6340), vol. 28, June 1986, p. 276-280.

The development of the Ames-Dryden Flight Research Facility is discussed. Factors which contributed to the expansion of the facility, and its capabilities are described. Consideration is given to aircraft and rocket development and flight testing at the facility and the use of the facility for the Space Shuttle. I.F.

A87-21320
SCIENCE FROM THE SPACE STATION
JOHN DAVIES Space Education (ISSN 0261-1813), vol. 1, Autumn-Winter 1986/87, p. 560-563.

The impact that the Space Station will have on many fields of science is considered. The main asset of the Space Station to astronomy may ultimately be the ability to assemble large instruments in orbit while microgravity experiments will focus on crystal growth and the preparation of new pharmaceutical products. Experiments in physics and chemistry will involve the search for phenomena predicted by various aspects of relativity theory. It is concluded that maximum involvement on the part of space scientists is essential from the onset of Space Station development. K.K.

A87-22554*# Stanford Univ., Calif.
SCIENCE IN SPACE WITH THE SPACE STATION
PETER M. BANKS (Stanford University, CA) AIAA, Aerospace Sciences Meeting, 25th, Reno, NV, Jan. 12-15, 1987. 4 p. Research supported by Stanford University.
(Contract NAGW-0235)
(AIAA PAPER 87-0316)

The potential of the Space Station as a versatile scientific laboratory is discussed, reviewing plans under consideration by the NASA Task Force on Scientific Uses of the Space Station. The special advantages offered by the Station for expanding the scope of 'space science' beyond astrophysics, geophysics, and terrestrial remote sensing are stressed. Topics examined include the advantages of a manned presence, the scientific value and cost effectiveness of smaller, more quickly performable experiments, improved communications for ground control of Station experiments, the international nature of the Station, the need for more scientist astronauts for the Station crew, Station on-orbit maintenance and repair services for coorbiting platforms, and the need for Shuttle testing of proposed Station laboratory equipment and procedures. T.K.

A87-22556*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
EARTH OBSERVING SYSTEM - THE EARTH RESEARCH SYSTEM OF THE 1990'S
JAMES E. GRAF (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) AIAA, Aerospace Sciences Meeting, 25th, Reno, NV, Jan. 12-15, 1987. 14 p. NASA-supported research. refs
(AIAA PAPER 87-0320)

The Earth Observing Systems' objective of comprehensively studying the earth's change leads to an array of technological and implementational challenges. Included in those challenges are in the in-orbit maintenance of fifty instruments through periodic servicing and the development of an international ground information system which permits rapid access to high quality data. The paper describes these challenges and also discusses potential contributions from international and USA agencies, mission design and payload groupings strategies, as well as design approaches to the spacecraft itself. Author

A87-22721#
COST REDUCTION ON LARGE SPACE SYSTEMS THROUGH COMMONALITY
R. D. WAISS (Boeing Aerospace Co., Seattle, WA) AIAA, Aerospace Sciences Meeting, 25th, Reno, NV, Jan. 12-15, 1987. 9 p. refs
(AIAA PAPER 87-0585)

The need for commonality in large space systems is discussed. The basic goal of a commonality program is to reduce total system cost by maximizing the use of standard and common parts, assemblies, subsystems, and/or systems. The application of commonality to the development, production, deployment, and operations of large space structure is examined. The economic benefits of a commonality approach to large space system development are evaluated. Consideration is given to mandated and nonmandate approaches for implementing commonality. I.F.

A87-22746*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PLANETARY EXPLORATION: TO BOLDLY GO - OR WHAT?
LEW ALLEN, JR. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) AIAA, Aerospace Sciences Meeting, 25th, Reno, NV, Jan. 12-15, 1987. 11 p. refs
(AIAA PAPER 87-0624)

The direction of solar system exploration in the U.S. is examined. Planetary exploration missions from 1961-1976 are reviewed. The objectives of the Viking and Voyager missions are described. The effects of launch vehicles and access to space, the cost of exploration, the balance of planetary exploration with other space sciences, and international planet exploration missions on future planetary exploration programs are discussed. Inner and outer solar system exploration, comet exploration, extensive human visitations to Mars, joint U.S.-Soviet programs, and exploration beyond the solar system are proposed as future planetary missions. I.F.

A87-23156
OPPORTUNITIES FOR ACADEMIC RESEARCH IN A LOW-GRAVITY ENVIRONMENT
GEORGE A. HAZELRIGG, ED. (NSF, Washington, DC) and JOSEPH M. REYNOLDS, ED. (Louisiana State University, Baton Rouge) New York, American Institute of Aeronautics and Astronautics, Inc. (Progress in Astronautics and Aeronautics. Volume 108), 1986, 339 p. For individual items see A87-23157 to A87-23167.

The possibilities offered by the Space Station and other space-infrastructure components for experimental research and measurements in the applied sciences and engineering are considered in reviews presented at the NSF workshop held in Washington, DC, on July 10, 11, 1985. Both the physics of the microgravity environment and the characteristics of space

laboratory facilities are addressed. Topics examined are infrastructures for low-gravity research, critical phenomena, gravitation, crystal growth, metals and alloys, containerless processing, combustion, and fluid dynamics. T.K.

A87-23276
ADVANCING MATERIALS RESEARCH
H. DALE LANGFORD, ED. (National Academy of Engineering, Washington, DC) and PETER A. PSARAS, ED. (IBM Corp., Thornwood, NY) Washington, DC, National Academy of Press, 1987, 407 p. For individual items see A87-23277 to A87-23281.

The topics discussed in this volume include historical perspectives in the fields of materials research and development, the status of selected scientific and technical areas, and current topics in materials research. Papers are presentd on progress and prospects in metallurgical research, microstructure and mechanical properties of metals, condensed-matter physics and materials research, quasi-periodic crystals, and new and artifically structured electronic and magnetic materials. Consideration is also given to materials research in catalysis, advanced ceramics, organic polymers, new ways of looking at surfaces, and materials synthesis and processing. I.S.

A87-23749
MISSIONS THAT NEVER WERE
ALAN STERN (Colorado, University, Boulder) Space World (ISSN 0038-6332), vol. W-11-275, Nov. 1986, p. 11-15.

Space missions that were planned and developed but never flown are recalled. Missions described include: Mercury-Atlas 10; Dyna-Soar; Manned Orbital Lab (MOL); Follow-on Ranger or Ranger Block V; Apollos 18, 19 and 20; Lunar Polar Orbiter (LPO); Voyager Mars; Skylab B; Skylab Rescue; Grand Tour (two spacecraft to visit Jupiter, Saturn and Pluto and two to visit Jupiter, Uranus and Neptune); Mariner Jupiter-Uranus; Halley-Tempel 2 (the official U.S. mission to Comet Halley); International Solar Polar Mission; Venus Orbiting Imaging Radar (VOIR); and the Shuttle referring to missions scrubbed STS-10, 41-E, 41-F, 41-H, 51-E and 51-K. Reasons for the cancellations (often budgetary) are noted, along with the impact of the actions. Some programs resurfaced under other names. Science often involves a tremendous effort with no results, holding up the example of a 1874 Transit of Venus expedition, sponsored by the U.S. Naval Observatory, which was intended to use triangulation and photography to measure the distance to Venus and the sun from widely separated points on the earth; weather spoiled almost all the observations and money could not be found to publish the limited results. D.H.

A87-25452#
SPACE INDUSTRIES' INDUSTRIAL SPACE FACILITY AND THE U.S. SPACE STATION PROGRAMS
MAXIME A. FAGET (Space Industries, Inc., Houston, TX) IN: Space Station: Gateway to space manufacturing; Proceedings of the Conference, Orlando, FL, Nov. 7, 8, 1985 . Arlington, VA, Pasha Publications, 1985, 19 p.

The expansion of commercial space materials-research and manufacturing opportunities with the deployment of the Space Station is discussed, and a Station-compatible industrial space facility (ISF) being developed for deployment before the Station becomes commercially available is described and illustrated with drawings. The ISF is based on a shirtsleeve-environment module of length 35 ft, diameter 14.5 ft, and internal volume 2500 cu ft, designed to be launched on one Shuttle flight to a circular orbit with inclination 28 deg and altitude 230 n. mi.; each module is capable of fully independent operation. It is predicted that the most important cost factor for space production will continue to be the transportation cost, so that only high-value materials such as semiconductor crystals and pharmaceuticals can be produced profitably; the need for further government subsidization of space-transportation costs is indicated. T.K.

A87-25460*# National Aeronautics and Space Administration, Washington, D.C.
NASA SMALL BUSINESS INNOVATION RESEARCH PROGRAM
HARRY W. JOHNSON (NASA, Small Business Innovation Research Office, Washington, DC) IN: Space Station: Gateway to space manufacturing; Proceedings of the Conference, Orlando, FL, Nov. 7, 8, 1985 . Arlington, VA, Pasha Publications, 1985, 20 p.

NASA activities in the framework of the 11-agency federal Small Business Innovation Research program are outlined in tables and graphs and briefly characterized. Statistics on the program are given; the technical topics covered are listed; and the procedures involved in evaluating applications for support are discussed. A number of typical defects in proposals are indicated, and recommendations for avoiding them are provided. T.K.

A87-25531
PARTNERSHIPS IN REMOTE SENSING - A THEME WITH SOME EXAMPLES
WILLIAM P. BISHOP (NOAA, National Environmental Satellite, Data, and Information Service, Washington, DC) Space Policy (ISSN 0265-9646), vol. 2, Nov. 1986, p. 322-341. refs

This article reviews the revolution in remote sensing which has taken place over the past 25 years. This revolution could not have occurred without the closest cooperation among government agencies, industry and academia. International cooperation is shown to be essential in carrying out the bold missions planned for the next decade. The article reviews the history of the NASA-NOAA relationship, and the history of international partnerships with emphasis on development of the operational Metsat system. The government-industry partnership is also reviewed, with case studies to examine the evolution of Metsat sensor design, Landsat commercialization, and the NOAA Administrator's new initiative to facilitate development of a commercial Ocean Color Instrument. Government interaction with academia, in the form of National Science Foundation programs and government-university 'cooperative institutes', is reviewed. The author concludes by showing how plans for integrating research and operations on Space Station platforms can only succeed through an alliance of all the remote-sensing players. Author

A87-25751
SPACE TECH '86; PROCEEDINGS OF THE INTERNATIONAL CONFERENCE, GENEVA, SWITZERLAND, MAY 14-16, 1986
London, Online International, Ltd., 1986, 261 p. For individual items see A87-25752 to A87-25769.

Papers are presented on the development of the Space Station, the Japanese laboratory proposal, and the Columbus program. Topics discussed include free flying platforms, the role of robotics in space, switches, lasers, and electronically-hopped beam antennas in space, new communications satellite configurations, geostationary platforms, the mobile communications satellite, and paging by satellite. Consideration is given to space transportation, in particular the Long March launcher, Ariane 5/Hermes, and Hotol. I.F.

A87-25765
HOTOL - THE APPLICATION OF ADVANCED TECHNOLOGY
R. C. PARKINSON (British Aerospace PLC, Space and Communications Div., Stevenage, England) and B. R. A. BURNS (British Aerospace, PLC, Military Aircraft Div., Warton, England) IN: Space Tech '86; Proceedings of the International Conference, Geneva, Switzerland, May 14-16, 1986 . London, Online International, Ltd., 1986, p. 177-185.

Hotol is a new initiative for a future European launch vehicle to reduce the costs of transportation into low earth orbit. It achieves its performance by using airbreathing propulsion for the early phases of its flight, turning into a 'pure' rocket for insertion into orbit. Reusability is only one facet of achieving low flight costs, reducing operational costs are equally important. Providing both low cost per kilogram and a low unit launch cost, Hotol could change many of the ways in which operations in space are conducted. Author

A87-25830
MICROGRAVITY RESEARCH, PRESENT STATUS AND FUTURE PROSPECTS
GUENTHER SEIBERT (ESA, Paris, France) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 10, Sept.-Oct. 1986, p. 304-311. refs

Aspects of microgravity research are discussed. The microgravity environment of near-earth orbits is described, and the allowable g-levels for microgravity payloads and the impact of gravitational forces on sedimentation, buoyancy, convection, and hydrostatic pressure are discussed. The results obtained to date from microgravity research are summarized for the areas of crystal growth, metallurgy and metallic composites, fluid sciences, biotechnology, human physiology, and cell and developmental biology. The near and long term prospects of microgravity research are addressed. C.D.

A87-26730
ANNUAL REVIEW OF ASTRONOMY AND ASTROPHYSICS. VOLUME 24
GEOFFREY BURBIDGE, ED. (California, University, San Diego), DAVID LAYZER, ED. (Harvard College Observatory, Cambridge, MA), and JOHN G. PHILLIPS, ED. (California, University, Berkeley) Palo Alto, CA, Annual Reviews, Inc., 1986, 634 p. For individual items see A87-26731 to A87-26745.

Recent progress made in the instrumentation, observational techniques and data analysis tools for studying various astrophysical and astronomical phenomena is explored. Features of the quiet solar transition region, the evolution of H II regions, and stellar molecules are discussed. Maximum entropy image restoration techniques are described, as are emission-line regions of active galaxies and QSOs, and the physics of supernova explosions and pulsars. Attention is given to the uses of CCDs in astronomy, the evolution of massive stars and cool stars with mass loss and the structure of magnetic fields in spiral galaxies. Optical and UV absorption-line studies of interstellar gas are outlined. The development of the population concept is traced and techniques for correcting for relativistic effects in pulsar timing measurements and performing star counts as an aid to modeling the structure of the Galaxy are summarized. M.S.K.

A87-27242
PLASTICS - A BIRDSEYE VIEW INTO THE FUTURE
Advanced Materials and Processes (ISSN 0026-0665), vol. 131, Jan. 1987, p. 32-34, 39, 40, 43.

Advanced plastics being developed in U.S. and Japanese government, academic, and industry laboratories are listed and briefly characterized in a general survey. Consideration is given to biomedical materials; improved blends, alloys, and composites; membranes and barriers; electrically conducting plastics; high-temperature materials; plastics with improved toughness; fire-resistant and clean-burning plastics; and high-strength fibers. T.K.

A87-27243
THE PROMISE OF CERAMICS
Advanced Materials and Processes (ISSN 0026-0665), vol. 131, Jan. 1987, p. 44-46, 49, 50.

Advanced ceramic materials and processing techiques are discussed in a survey of ongoing R&D efforts in the U.S. and Japan. Recent projections of rapid growth in the market for ceramics (especially for heat-engine applications) are examined, and it is pointed out that even the more conservative projections require technological breakthroughs in a number of areas, including statistical analysis and reliability design of ceramic components, forming and sintering techniques (to reduce the size and number of flaws), cost reduction, thermodynamic and mechanical stability, and NDE technology. Special consideration is given to alternatives to conventional sintering, such as microwave heating, chemically activated diffusion, welding to build up multilayer components, and chemical-vapor infiltration or deposition to prepare ceramic-ceramic composites. T.K.

A87-27815
SPACE STATION - MORE SHAKE-UPS AND SCRUB-DOWNS
CHRIS BULLOCH Interavia (ISSN 0020-5168), vol. 41, Dec. 1986, p. 1415-1417.

An account is given of configurational modifications and changes in construction and development responsibility that have recently been instituted as a result of ongoing Space Station program management studies by NASA. Attention is given to a revision of the Space Station assembly sequence which attempts to spread out Space Shuttle payload lofting schedules; the final configuration of the 'dual-keel' Space Station is not expected to be achieved before the 17th Space Shuttle flight, even with liberal use of expendable launchers in the process. Also discussed are the U.S. Congress' Office of Technology Assessment determinations and recommendations concerning legal and jurisdictional problems in the Space Station program. O.C.

A87-28952
THE SPACE STATION IN CHEMICAL AND PHARMACEUTICAL RESEARCH AND MANUFACTURING
M. J. LEGGETT (Caribonum, Ltd., Turriff, Scotland) British Interplanetary Society, Journal (Space Stations) (ISSN 0007-084X), vol. 40, Jan. 1987, p. 11-18. refs

This paper examines materials processing in space and microgravity research in the chemical and pharmaceutical sciences in relation to Space Station exploitation. Current industrial activity, and some potential future activity, in several areas of chemistry are discussed. These areas include inorganic and organic chemistry (fluids, polymers, and free radicals), applied solid state chemistry and molecular electronics (crystal growth for electronics, radiation detectors, and electro-optical devices) and medicinal/pharmaceutical chemistry (protein crystal growth and drug design). The scientific and economic importance of these areas is also discussed. User and operational requirements for chemical and pharmaceutical utilization of the Space Station are also briefly discussed. These include justification for the manned Space Station, user requirements, health and safety, and space commercialization. The potential of space processing lies initially in research. Such research could be performed in support of ground-based research, or applied to optimize earth-based processes. Microgravity research should also identify products, probably fine chemicals, that can only be manufactured in space. Author
Author

A87-28954
INTERNATIONAL USE OF NATIONAL SPACE STATION FACILITIES
S. R. DAUNCEY (General Technology Systems, Ltd., Brentford, England) British Interplanetary Society, Journal (Space Stations) (ISSN 0007-084X), vol. 40, Jan. 1987, p. 27-31.

The purpose of this paper is to raise consciousness as to the need to plan the use of Space Station as an ongoing organism. This is done by trying to give a picture of what the Space Station may become, mentioning some possibly comparable organizations and suggesting some analogies (leaving it to the reader to think in more detail about the lessons to be learned) and drawing some very tentative conclusions. Author

A87-30876
SPACE SCIENCE AND APPLICATIONS: PROGRESS AND POTENTIAL
JOHN H. MCELROY, ED. (Hughes Aircraft Co., Space and Communications Group, Los Angeles, CA) New York, IEEE Press, 1986, 270 p. For individual items see A87-30877 to A87-30893.

The evolution, growth, goals and applications of space technologies and capabilities are explored in depth. Experimentation using manned and unmanned spacecraft, Skylab, and the Shuttle to explore sun-earth relations, phenomena and planetary bodies in the solar system, observe and measure astrophysical phenomena, and perform life sciences studies are described. The applications, data collected, and future systems for remote sensing of the earth are summarized. Past, present, and future studies of and industrial scale performance of processing

materials in space are examined, with emphasis on NASA efforts to foster commercial development in this area. Finally, the evolution and capabilities of the technologies, designs, and applications of satellites communications systems for data transfer, navigation, telephony, television broadcasts, etc., is traced. The impacts the Space Station and related systems will have on current and future operational space systems are also explored. M.S.K.

A87-30878* National Aeronautics and Space Administration, Washington, D.C.
SOLAR SYSTEM EXPLORATION
GEOFFREY A. BRIGGS and WILLIAM L. QUAIDE (NASA, Solar System Exploration Div., Washington, DC) IN: Space science and applications: Progress and potential . New York, IEEE Press, 1986, p. 19-29.

Two fundamental goals lie at the heart of U.S. solar system exploration efforts: first, to characterize the evolution of the solar system; second, to understand the processes which produced life. Progress in planetary science is traced from Newton's definition of the principles of gravitation through a variety of NASA planetary probes in orbit, on other planets and traveling beyond the solar system. It is noted that most of the planetary data collected by space probes are always eventually applied to improving the understanding of the earth, moon, Venus and Mars, the planets of greatest interest to humans. Significant data gathered by the Mariner, Viking, Apollo, Pioneer, and Voyager spacecraft are summarized, along with the required mission support capabilities and mission profiles. Proposed and planned future missions to Jupiter, Saturn, Titan, the asteroids and for a comet rendzvous are described. M.S.K.

A87-30880* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NASA'S LIFE SCIENCES PROGRAM
GERALD A. SOFFEN (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: Space science and applications: Progress and potential . New York, IEEE Press, 1986, p. 55-68.

NASA space missions from the Mercury through the Shuttle program have provided successively more data on the ability of humans to function in space for progressively longer periods of time. The Skylab program encouraged cooperation between medical and engineering personnel in the design of space suits, diet, food preparation, and cleanliness procedures and equipment, and the man-machine interface. Research is now concentrated on supporting man in space, evaluating the effects of the microgravity environment on humans, and modeling encounters with extraterrestrial life and the effects of human activities on terrestrial biota. Current levels of understanding of the physiological causes of human health problems produced by long-duration spaceflight are summarized. Experiments planned for the Shuttle, Spacelab, and the Space Station are outlined, noting the long-term goal of configuring the Space Station so that only food and hydrazine are needed to complete the life support system cycle. M.S.K.

A87-30893* National Aeronautics and Space Administration, Washington, D.C.
COMMUNICATIONS TECHNOLOGY
C. LOUIS CUCCIA (NASA, Washington, DC) and JOSEPH SIVO IN: Space science and applications: Progress and potential . New York, IEEE Press, 1986, p. 227-250.

The technologies for optimized, i.e., state of the art, operation of satellite-based communications systems are surveyed. Features of spaceborne active repeater systems, low-noise signal amplifiers, power amplifiers, and high frequency switches are described. Design features and capabilities of various satellite antenna systems are discussed, including multiple beam, shaped reflector shaped beam, offset reflector multiple beam, and mm-wave and laser antenna systems. Attitude control systems used with the antenna systems are explored, along with multiplexers, filters, and power generation, conditioning and amplification systems. The operational significance and techniques for exploiting channel bandwidth, baseband and modulation technologies are described. Finally, interconnectivity among communications satellites by means of RF and laser links is examined, as are the roles to be played by the Space Station and future large space antenna systems. M.S.K.

A87-31123*# National Aeronautics and Space Administration, Washington, D.C.
NASA'S TECHNOLOGY PLANS - WILL TECHNOLOGY BE READY WHEN WE ARE
RAYMOND S. COLLADAY (NASA, Office of Aeronautics and Space Technology, Washington, DC) AIAA, NASA, and USAF, Symposium on Automation, Robotics and Advanced Computing for the National Space Program, 2nd, Arlington, VA, Mar. 9-11, 1987. 5 p.
(AIAA PAPER 87-1695)

Recent low NASA science and technology budgets impacted unfavorably on trade balances of aerospace products and lags in several technological areas impinged on other areas already in application which could not be exploited or did not achieve desired performance levels. NASA has formed a Civil Space Technology Initiative, for 1988 start, to foster research on safe and efficient access to space, earth orbiting operations, and science support technologies. R&D programs for fully reusable launch systems, aerobraking concepts, and a multi-arm, highly autonomous capability for space-based remote assembly, repair and servicing of space vehicles are described. Regarding science, emphasis will be placed on large flexible structures and the associated control programs, sensors and data handling and analysis equipment and programs. Finally, technologies common to human activities in regions beyond the Space Station are to be explored in the second phase of the NASA initiative, Pathfinder. M.S.K.

A87-32601
SUPERSONIC CRUISE TECHNOLOGY ROADMAP
ROGER L. WINBLADE SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 9 p.
(SAE PAPER 861685)

One of the three National Aeronautical R&D Goals of the President's Office of Science and Technology Policy was the attainment of long-distance supersonic cruise capability. NASA was asked to lead the development of a 'technology roadmap' for this goal. The roadmap identified critical technology elements that need to be pursued and provided an outline of the most effective approach for achieving technology readiness. The effort, briefly addressed in this paper, was intended to provide a first top level framework to support the preparation of more detailed technical plans through the combined efforts of private and public sectors of the aeronautics communicty. Author

A87-32633
A SIMULATION CAPABILITY FOR FUTURE SPACE FLIGHT
RICHARD A. SKIDMORE and ROBERT PULLIAM (Martin Marietta Corp., Denver, CO) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 8 p.
(SAE PAPER 861784)

The limited number of laboratories which can simulate operations in space provide a critical engineering resource. Among these the Martin Marietta Space Operations Simulator Laboratory in Denver provides resources for real-time piloted flight and other human/machine simulations. Its facilities include a 6 degree-of-freedom (DOF), man-rated carriage with a 3 DOF target gimbal, which is computer driven to simulate flight in space. This system can simulate astronaut freeflight, or the relative motion of any two bodies in space. Other resouces include a manipulator arm, a neutral bouyancy tank, a Shuttle Orbiter aft flight deck mockup, and a large screenflight simulator. Recently developed is computer generated imagery for low cost space simulation, with 3-body motion, flexible body dynamics, and simulated handling of payloads at the Space Station. Advanced pilot consoles are used to control simulations and for control-display experiments. New resources are being developed. Author

A87-33551
STRUCTURES, STRUCTURAL DYNAMICS AND MATERIALS CONFERENCE, 28TH, MONTEREY, CA, APR. 6-8, 1987, TECHNICAL PAPERS. PART 1
Conference sponsored by AIAA, ASME, ASCE, and AHS. New York, American Institute of Aeronautics and Astronautics, 1987, 884 p. For individual items see A87-33552 to A87-33653.

The present conference considers the structural behavior of solid rocket motor field joints, design engineering technologies for aerospace vehicles, the generalization of an equivalent plate representation for aircraft structural analysis, control-augmented structural synthesis with transient response constraints, the optimal design of flexible arches, compressive deformation in polymer fibers, a probabilistic Hu-Washizu variational principle, the extension-twist coupling of composite circular tubes for tilt rotor blade applications, and a creep-rupture model of filament-wound spherical pressure vessels. Also discussed are tough advanced composite structures, simultaneous structure/control optimization of large flexible spacecraft, improved optimum design of dewar supports, the shear strength of structural adhesives, the performance of trigonometric-basis function finite elements in Timoshenko beams, on-orbit damage assessment for large space structures, and the structural tailoring of advanced turboprops. O.C.

A87-33654
STRUCTURES, STRUCTURAL DYNAMICS AND MATERIALS CONFERENCE, 28TH, MONTEREY, CA, APR. 6-8, 1987 AND AIAA DYNAMICS SPECIALISTS CONFERENCE, MONTEREY, CA, APR. 9, 10, 1987, TECHNICAL PAPERS. PARTS 2A & 2B
Conferences sponsored by AIAA, ASME, ASCE, and AHS. New York, American Institute of Aeronautics and Astronautics, 1987. Pt. 2A, 585 p.; pt. 2B, 572 p. For individual items see A87-33655 to A87-33761.

Papers are presented on an aeroelatic analysis of launch vehicles in transonic flight, the dynamical response to pulse excitations in large space structures, an analytical flutter investigation of a composite propfan model, and an analysis of Intelsat V flight data. Also considered are the effective stiffness of a structural component under parametric dynamic loading, the effect of nonlinearities on the dynamic response of a large Shuttle payload, and active suppression of an apparent shock induced instability. Other topics include positive position feedback control for large space structures, a flutter analysis of aeronautical composite structures by an improved supersonic kernel function method, and aeroelastic characteristics of swept circulation control wings. Papers are also presented on dynamic and attitude control characteristics of an International Space Station, wave propagation in periodic truss structures, and the hingeless rotor response to random gusts in forward flight. R.R.

A87-34871
SPACE STATION - OPPORTUNITIES FOR THE LIFE SCIENCES
M. H. HARRISON (RAF, Institute of Aviation Medicine, Farnborough, England) British Interplanetary Society, Journal (Space Chronicle) (ISSN 0007-084X), vol. 40, March 1987, p. 117-124. refs

Opportunities for bioprocessing, basic biological research and space medicine offered by the Space Station are examined. Space offers two conditions which are duplicated on earth only with great difficulty; microgravity and high vacuum. Microgravity permits enhanced control of temperature and concentration gradients and particle distributions in fluids and containerless processing. Several likely candidates for electrophoresis processing in space are identified, noting that the greatest obstacle to realizing the new industry is commercial doubts as to its viability. Areas of cell and animal physiology, radiation biology, and exobiology that would benefit from Space Station research are considered. Finally, necessary space medicine research, by NASA and ESA, in medicine, toxicology, human factors, psychology, and adaptation to microgravity in support of the Space Station program are explored. M.S.K.

A87-36298
X-WING - AN AIRCRAFT FOR THE 21ST CENTURY
JOHN G. SUTTON and ANTHONY C. SAWICKI (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) SAWE, Annual Conference, 45th, Williamsburg, VA, May 12-14, 1986. 19 p.
(SAWE PAPER 1732)

The X-wing concept offers the potential of being the first VTOL concept to provide efficient hover performance and fixed wing flight cruise speed (to Mach 0.8) without the weight penalties associated with dual lift systems. The X-wing is a four bladed, extremely rigid rotor/wing which can be started and stopped in flight and uses circulation control blowing (Coanda effect) to produce lift and control. The concept has been under development for over 15 years and has reached the flight test hardware stage. Current and emerging technologies provide the basis for X-wing air vehicles to be competitive in both weight empty fraction and payload/range. An X-wing aircraft has the potential of meeting and exceeding the requirements of many U.S. Navy missions. Anticipated in-service date for production aircraft would be approximately the year 2000. D.H.

A87-37298* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
REAL-TIME SIMULATION FOR SPACE STATION
ROBERT H. ST. JOHN (NASA, Johnson Space Center, Houston, TX), GERARD J. MOORMAN, and BLAINE W. BROWN (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IEEE, Proceedings (ISSN 0018-9219), vol. 75, March 1987, p. 383-398. refs

Development of a new Space Station simulation designed to provide long-term support to the Space Station Program is well under way. A description of the two Engineering Directorate simulation facilities, the Systems Engineering Simulator and the Shuttle Avionics Integration Laboratory, is presented. The function of each in support of the Space Shuttle Program is discussed, with emphasis on functions applicable to Space Station. The function of the Systems Engineering Simulator in Space Station development is described. Finally, a comprehensive and detailed description of the new Space Station simulation under development on the System Engineering Simulator is presented. Author

A87-37968* Bell Telephone Labs., Inc., Murray Hill, N. J.
A CRISIS IN THE NASA SPACE AND EARTH SCIENCES PROGRAMME
LOUIS LANZEROTTI, J. (AT&T Bell Telephone Laboratories, Murray Hill, NJ), JEFFREY D. ROSENDHAL, DAVID C. BLACK (NASA, Washington, DC), D. JAMES BAKER (Joint Oceoanographic Institutions, Inc., Washington, DC), PETER M. BANKS (Stanford University, CA), FRANCIS BRETHERTON (National Center for Atmospheric Research, Boulder, CO), ROBERT A. BROWN (Space Telescope Science Institute, Baltimore, MD), KEVIN C. BURKE (Lunar and Planetary Institute, Houston, TX), JOSEPH A. BURNS (Cornell University, Ithaca, NY), CLAUDE R. CANIZARES (MIT, Cambridge, MA) et al. Space Policy (ISSN 0265-9646), vol. 3, Feb. 1987, p. 38-51.

Problems in the space and earth science programs are examined. Changes in the research environment and requirements for the space and earth sciences, for example from small Explorer missions to multispacecraft missions, have been observed. The need to expand the computational capabilities for space and earth sciences is discussed. The effects of fluctuations in funding, program delays, the limited number of space flights, and the development of the Space Station on research in the areas of astronomy and astrophysics, planetary exploration, solar and space physics, and earth science are analyzed. The recommendations of the Space and Earth Science Advisory Committee on the development and maintenance of effective space and earth sciences programs are described. I.F.

A87-38742* General Electric Co., Philadelphia, Pa.
SCIENCE RESEARCH FACILITIES - VERSATILITY FOR SPACE STATION
J. A. GIANNOVARIO, J. D. SCHELKOPF, K. MASSEY, and M. SOLLY (General Electric Co., Space Div., Valley Forge, PA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 435-438.
(Contract NAS5-29300)
(SAE PAPER 860958)

The Space Station Science Lab Module (SLM) and its interfaces are designed to minimize complexity and maximize user accommodations. The facilities provided encompass life sciences research, the control of external payloads, the servicing of customer equipment, and general scientific investigations. The SLM will have the unprecedented ability to diagnose, service, and replace equipment while in orbit. In addition, the SLM will have significant operational advantages over previous spacecraft in terms of available volume, power, and crew interaction possibilities. O.C.

A87-38748
COLUMBUS LIFE SUPPORT SYSTEM AND ITS TECHNOLOGY DEVELOPMENT
H. P. LEISEIFER, A. I. SKOOG, and H. PREISS (Dornier System GmbH, Friedrichshafen, West Germany) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 485-497. ESA-BMFT-supported research. refs
(SAE PAPER 860966)

The ESA's Columbus program element of the NASA Space Station employs a Pressurized Module (PM) whose Environmental Control and Life Support Subsystem (ECLSS) baseline is presently discussed for the case of PM attachment to the Space Station and in view of comparisons with the Spacelab ECLSS. A systems approach is used in these considerations, and technology readiness and development requirements are identified in light of hardware-related ECLSS design factors. Technology implementation goals are then formulated. The PM ECLSS undertakes atmospheric pressure and composition control, CO2 management, atmospheric contamination management, cabin temperature and humidity management, avionics and experiment cooling, fire detection and suppression, water and waste management, and power and thermal budgeting. O.C.

A87-38752* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LIFE SCIENCES RESEARCH FACILITY AUTOMATION REQUIREMENTS AND CONCEPTS FOR THE SPACE STATION
DARYL N. RASMUSSEN (NASA, Ames Research Center, Moffett Field, CA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 539-552.
(SAE PAPER 860970)

An evaluation is made of the methods and preliminary results of a study on prospects for the automation of the NASA Space Station's Life Sciences Research Facility. In order to remain within current Space Station resource allocations, approximately 85 percent of planned life science experiment tasks must be automated; these tasks encompass specimen care and feeding, cage and instrument cleaning, data acquisition and control, sample analysis, waste management, instrument calibration, materials inventory and management, and janitorial work. Task automation will free crews for specimen manipulation, tissue sampling, data interpretation and communication with ground controllers, and experiment management. O.C.

A87-40366
THE MAGELLAN SPACECRAFT, ITS DESIGN, MISSION AND CHALLENGES
CHARLES D. BROWN (Martin Marietta Corp., Denver, CO) IN: EASCON '86; Proceedings of the Nineteenth Annual Electronics and Aerospace Systems Conference, Washington, DC, Sept. 8-10, 1986 . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 146-150. refs

The Magellan project is the next major step to be taken by the U.S. in the exploration of Venus. In 1990 the radar carrying spacecraft will start sending back the digital images which will become a topographical map of the surface of the planet. The resolution will be equivalent to that of Mariner 9 which first mapped Mars. Gravity and altimetry measurements will be made as well. The purpose of the project is to provide data for scientific investigation of the geological processes that occurred there. The spacecraft is a three-axis stabilized, fine pointing, Venus orbiter. The spacecraft, its subsystems, its challenges, and its history are described. Author

A87-40842*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FERRY TO THE MOON
GRAEME ASTON (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) Aerospace America (ISSN 0740-722X), vol. 25, June 1987, p. 30-32.

Solar-electric propulsion for a fleet of lunar ferry vehicles may allow the creation of a permanent lunar base not long after the turn of the century with greater cost effectiveness than a fleet of chemically powered spacecraft. After delivery by the Space Shuttle to a 300-km earth orbit, the lunar ferry envisioned would travel in spiral trajectory to the moon under the power of 300-kW solar arrays and ten 30-kW Xe-ion engines; each of the solar arrays would be 12 x 61 m long. Each trip between the earth parking orbit and the moon would take about 1 year, so that a fleet of four ferries operating simultaneously could deliver 20 metric tons to a lunar base every 100 days. O.C.

A87-41155*# Oak Ridge National Lab., Tenn.
TELEROBOTIC TECHNOLOGY FOR NUCLEAR AND SPACE APPLICATIONS
J. N. HERNDON and WILLIAM R. HAMEL (Oak Ridge National Laboratory, TN) AIAA, NASA, and USAF, Symposium on Automation, Robotics and Advanced Computing for the National Space Program, 2nd, Arlington, VA, Mar. 9-11, 1987. 13 p. NASA-sponsored research. refs
(Contract DE-AC05-84OR-21400)
(AIAA PAPER 87-1690)

Developments in telerobotics applicable to nuclear and space environments are discussed. The advanced servomanipulator (ASM) slave arm force-reflected servomanipulators designed for modular remote maintainability of the Advanced Integrated Maintenance System is examined. Consideration is given to the master controller, transporter, interface package, operator control station, and the control system for the ASM arm. A prototype of a telerobot capable of performing the activity of an astronaut during EVA is developed. The mechanical and control system features of the telerobot are described. I.F.

A87-41568
SPACE: NEW OPPORTUNITIES FOR ALL PEOPLE; SELECTED PROCEEDINGS OF THE THIRTY-SEVENTH INTERNATIONAL ASTRONAUTICAL CONGRESS, INNSBRUCK, AUSTRIA, OCT. 4-11, 1986
L. G. NAPOLITANO, ED. (Napoli, Universita, Naples, Italy) Congress sponsored by IAF. Acta Astronautica (ISSN 0094-5765), vol. 16, 1987, 402 p. For individual items see A87-41570 to A87-41575.

The present conference on astronautics considers the NASA Automation and Robotics Technology Program, the objectives and design of the Columbus system, a NASA Space Station development status assessment, international commonality for the Space Station, the Voyager Uranus mission, trends in space

transportation, advanced space propulsion concepts, a model test vehicle for hypersonic aerospace system development, and satellite autonomous navigation employing Navsat. Also discussed are the DORIS orbitography and positioning system, a quality assessment of SPOT 1 images, an evaluation of mobile satellite systems, mobile communications, navigation and surveillance, a closed Brayton solar dynamic power system for the Space Station, hydrocarbon rocket propulsion technology, and the Hermes shuttle thermal protection system. O.C.

A87-41572
TRENDS IN SPACE TRANSPORTATION
R. F. BRODSKY (TRW, Inc., TRW Space and Technology Group, Redondo Beach, CA) and M. G. WOLFE (Aerospace Corp., Los Angeles, CA) (IAF, International Astronautical Congress on Space: New Opportunities for all People, 37th, Innsbruck, Austria, Oct. 4-11, 1986) Acta Astronautica (ISSN 0094-5765), vol. 16, 1987, p. 105-112.

An evaluation is made of emerging design trends in third-generation launch vehicle concepts being entertained in the U.S., Western Europe, and Soviet Union. Novel concepts encompass the horizontal-takeoff-and-landing SSTO, Space Shuttle-derived vehicles, and mammoth heavy lift vehicles. The projected performance capabilities and economic feasibility of these systems are compared. While civilian uses for these vehicles will encompass the extension of current communications and earth observation capabilities and the support of further planetary expeditions, military applications will be dominated by the requirements of the reconnaissance and communication tasks that will be included in the Strategic Defense Initiative system as well as by the constitution of a permanent weapons capability in space. O.C.

A87-42482* Colorado State Univ., Fort Collins.
FIRE - THE FIRST ISCCP REGIONAL EXPERIMENT
STEPHEN K. COX (Colorado State University, Fort Collins), DAVID S. MCDOUGAL (NASA, Langley Research Center, Hampton, VA), DAVID A. RANDALL (NASA, Goddard Space Flight Center, Greenbelt, MD), and ROBERT A. SCHIFFER (NASA, Office of Space Science and Applications, Washington, DC) American Meteorological Society, Bulletin (ISSN 0003-0007), vol. 68, Feb. 1987, p. 114-118.

The First International Satellite Cloud Climatology Project Regional Experiment (FIRE) designed to study the roles of clouds, in particular marine stratocumulus and cirrus-cloud systems, in the global climate is discussed. The objectives of FIRE are: (1) to develop a cloud-classification scheme; (2) to validate and improve satellite cloud-retrieval techniques; (3) to improve cloud radiation models; (4) to collect cloud space/time statistics; (5) to improve cloud dynamics models; and (6) to validate and improve GCM cloud parameterizations. The methods used to acquire extended time data and intensive field observations are described. The extended time and intensive field data collected during the FIRE are to be archived in the NASA Pilot Climate Data System at Goddard Space Flight Center. I.F.

A87-44252
EUROPE'S PLANETARY PROGRAMS
ANDREW WILSON Interavia (ISSN 0020-5168), vol. 42, May 1987, p. 491, 492, 495.

An evaluation is made of current ESA participation in the NASA Galileo and Ulysses deep space missions. Although Galileo, when approved in 1977, was to have been launched in 1982, current launch date projections are in 1989 due to Space Shuttle inactivity. In addition, the June 1986 decision by NASA to delete the Centaur high energy upper stage from the Space Shuttle has made it impossible for either Galileo or Ulysses to reach their destinations before the 1990s. Evaluations are also made of Giotto, Caesar, and the Cassini Saturn orbiter/Titan atmosphere probe. O.C.

A87-44255 Operations Research, Inc., Rockville, Md.
ROTORCRAFT RESEARCH - A NATIONAL EFFORT (THE 1986 ALEXANDER NIKOLSKY HONORARY LECTURESHIP)
JOHN F. WARD (ORI, Inc., Aeronautics and Space Technology Div., Rockville, MD) American Helicopter Society, Journal (ISSN 0002-8711), vol. 32, April 1987, p. 3-20. Research supported by the American Helicopter Society, ORI, Inc., U.S. Army, and NASA. refs

The present history of rotary-wing and VTOL aircraft development initiatives in the U.S. notes that most such R&D efforts have tended to be 'threat-driven'; the threat has in recent years passed from one of a primarily military character to one of global civilian market growth competition. Recommendations are made concerning remaining research requirements in rotorcraft fluid dynamics, structural mechanics, and human factors engineering. Next-generation configurations to be intensively developed encompass tilt-rotors, advancing blade concept helicopters, convertible X-wings, and folding-blade tilt-rotors. O.C.

A87-44375
SPACE THE NEXT TWENTY-FIVE YEARS
THOMAS R. MCDONOUGH (California Institute of Technology, Pasadena) New York, John Wiley and Sons, Inc., 1987, 250 p. refs

Prospects for the next 25 years of the U.S. space program are considered. Technical advances that may lead to lunar bases, the development of the Strategic Defense Initiative, interstellar travel, the use of robots in space, space stations, and new SETI methods are examined. Possible scientific missions to study the inner planets, Mars, the asteroids and comets, the outer planets, and the universe are discussed. C.D.

A87-45509
ADVANCED COMMUNICATION TECHNOLOGY SATELLITE - SYSTEM DESCRIPTION
JOHN C. GRAEBNER and WILLIAM F. CASHMAN (RCA, Astro-Electronics Div., Princeton, NJ) IN: GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volume 1 . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 559-567.

NASA's Advanced Communication Technology Satellite (ACTS) program aimed at developing the technology necessary for future satellite communications is discussed. The ACTS system, designed for Ka-band applications, consists of a flight segment, ground segment, and experimenter terminals. The components and functions of each of these elements are described. Particular attention is given to the the multibeam communication package, the laser communication subsystem, the spacecraft bus, baseband processor mode and microwave switch mode networks, Ka-band receiving and transmitting equipment, the multibeam antenna, and high-speed SMSK modes. I.F.

A87-45513* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ACTS EXPERIMENTS PROGRAM
RONALD J. SCHERTLER (NASA, Lewis Research Center, Cleveland, OH) IN: GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volume 1 . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 584-592. refs

NASA's Advanced Communications Technology Satellite which will flight test the advanced technologies associated with a Ka-band multibeam antenna, onboard signal processing and switching, and laser communications is described. The ACTS Experiment Program includes flight system technology experiments, ground system technology experiments, network control, propagation experiments, and end-to-end system experiments. Operational communications modes employing the baseband processor and microwave switch matrix are presented as well as the antenna coverage pattern. K.K.

A87-45560
THE OPERATIONS CONTROL CENTRE
D. E. B. WILKINS (ESA, European Space Operations Centre, Darmstadt, West Germany) British Interplanetary Society, Journal (Space Technology) (ISSN 0007-084X), vol. 40, June 1987, p. 243-256.

This article describes the European Space Operations Centre, ESOC, which is located in Darmstadt, West Germany and gives an account of the historical events which led up to the design of the present facilities. A brief mention of the events of the last 20 years is made, together with a description of the way in which the stations of the ground network interface with the ESOC. The interrelationship between the advances in ground station facilities, spacecraft design, and increasingly greater launch payloads, and the control center, is described in detail. Author

A87-46182#
U.S. AERONAUTICAL R&D GOALS - SST: BRIDGE TO THE NEXT CENTURY
JOHN M. SWIHART (Boeing Co., Seattle, WA) IN: International Symposium on Air Breathing Engines, 8th, Cincinnati, OH, June 14-19, 1987, Proceedings . New York, American Institute of Aeronautics and Astronautics, 1987, p. 55-65.

The present technology development status evaluation of SST-related research trends in the past 15 years of NASA-sponsored efforts gives initial attention to the comparative advantages obtainable through next-generation subsonic transport technology. An assessment is then made of the gains over first-generation SST performance that would be obtainable through incorporation of supersonic flow laminarization to improve lift/drag and thereby reduce gross weight and sonic boom, the use of thermoplastic matrix resin composites and superplastically formed titanium alloy matrix structures, novel flight management systems, and advanced variable cycle engines employing supersonic fans and generating more acceptable noise levels. The further range of design options available for hypersonic transport design is discussed. O.C.

A87-46692#
NEW INSTRUMENTATION TECHNIQUES IN GEODESY
CHRISTOPHER JEKELI (USAF, Geophysics Laboratory, Hanscom AFB, MA) Reviews of Geophysics (ISSN 8755-1209), vol. 25, June 1987, p. 889-894. refs

New instrumentation techniques for geodetic studies, developed during the period of 1983-1986 are discussed. Special attention is given to the Global Positioning System of satellites that has virtually revolutionized geodesy, yielding data on precise positioning and baseline determination, time dissemination, geoid computations, earth rotation monitoring, and navigation and satellite tracking. Consideration is also given to improvements in inertial positioning systems and gravimetry instrumentation, radar altimetry from satellites, and the laser ranging from aircraft. In addition, geodetic applications of active and passive optical inertial rotation sensors, the tethered satellite-subsatellite system, and VLBI methodology are discussed. I.S.

A87-48676
THE LAND SATELLITE (LANDSAT) SYSTEM - EARTH OBSERVATION SATELLITE COMPANY (EOSAT'S) PLANS FOR LANDSAT-6 AND BEYOND
JACK ENGEL (Santa Barbara Research Center, Goleta, CA) IN: Earth remote sensing using the Landsat Thematic Mapper and SPOT sensor systems; Proceedings of the Meeting, Innsbruck, Austria, Apr. 15-17, 1986 . Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1986, p. 169-174.

This paper describes Eosat plans for operating the Landsat system in the Landsat-6,7 era (1985 to 1995). The paper provides background information relative to Eosat and an overview of the planned configurations of both the space segment (spacecraft and Enhanced Thematic Mapper), and the ground segment (Spacecraft Operations Center, Data Capture Site, and Eosat Processing Center) for Landsats 6 and 7. The planned enhancements to the Landsat-6/7 TMs are described in some detail, including the implementation of a panchromatic band of detectors providing 15-m spatial resolution on both ETM sensors and the possible inclusion on the Landsat-7 ETM of as many as five bands of thermal detectors with 120/60-m spatial resolution. Author

A87-48801
CANADIAN SYMPOSIUM ON REMOTE SENSING, 10TH, EDMONTON, CANADA, MAY 5-8, 1986, PROCEEDINGS. VOLUME 1 & 2
M. DIANE THOMPSON, ED. (Intera Technologies, Ltd., Calgary, Canada) and RONALD J. BROWN, ED. (Canada Centre for Remote Sensing, Ottawa, Canada) Symposium sponsored by the Canadian Remote Sensing Society, Canada Centre for Remote Sensing, and Canadian Institute of Surveying. Ottawa, Canadian Aeronautics and Space Institute, 1987. Vol. 1, 607 p.; vol. 2, 565 p. In English and French. For individual items see A87-48802 to A87-48907.

Topics discussed include spatial filtering of digital Landsat data for the extraction of mapping information; the application of accuracy assessment techniques to image classification; the inventory of wetlands with the Landsat TM; an airborne programmable imaging spectrometer for geobotanical applications; and spectral and textural segmentation of multispectral aerial images. Papers are presented on a high-throughput system for bulk processing of multispectral imagery; the influence of melting conditions on the interpretation of radar imagery of sea ice; the application of low altitude sample photography to national land use mapping; the use of satellite derived digital elevation models for resource mapping; and mapping effluent plumes with digitally enhanced and classified aerial photography. Consideration is given to the optimization of seismic vessel deployment using side looking airborne radar; validation and simulation of Radarsat imagery; remote sensing and agricultural resource inventory; the classification of TM data; and the Canadian SPOT program. I.F.

A87-50003* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MARINER 2 AND BEYOND - PLANETARY EXPLORATION'S FIRST 25 YEARS
FRANKLIN O'DONNELL (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IEEE Aerospace and Electronic Systems Magazine (ISSN 0885-8985), vol. 2, Aug. 1987, p. 2-6.

Mariner explorations of Venus and Mars are briefly described. Consideration is then given to the missions of Viking 1 and 2, Pioneer 10 and 11, Voyager 1 and 2, and Pioneer Venus. Projected future missions are also briefly considered, including Magellan, Galileo, and Ulysses. B.J.

A87-50751* Fermi National Accelerator Lab., Batavia, Ill.
ADVANCES IN CRYOGENIC ENGINEERING. VOLUME 31; PROCEEDINGS OF THE CRYOGENIC ENGINEERING CONFERENCE, MIT, CAMBRIDGE, MA, AUG. 12-16, 1985
R. W. FAST, ED. (Fermi National Accelerator Laboratory, Batavia, IL) Conference supported by the Air Products Foundation, General Dynamics Corp., NASA, et al. New York, Plenum Press, 1986, 1368 p. For individual items see A87-50752 to A87-50783.

The present conference on the applications of state-of-the-art cryogenic engineering technologies considers topics associated with the development status of the 'Superconducting SuperCollider', superconducting magnetic energy storage methods, large magnets for fusion and other physics researches, cryogenic hardware improvements, and phenomena and applications of superconducting magnet-employing acoustic emission test equipment. Also discussed are design criteria for superconducting magnet stability, heat exchangers and heat transfer to liquid He and N, heat and mass transfer characteristics of He II, refrigeration techniques for magnetic resonance imaging and other small systems, refrigeration for liquefaction and for superconducting fusion as well as for accelerator and generator systems, magnetic refrigeration, cryocooling and refrigeration for space applications, the storage and transfer of cryogenic fluids, the properties of cryogenic liquids, and air liquefaction equipment. O.C.

A87-51772
DEVELOPMENT OF METAL MATRIX COMPOSITES IN R & D INSTITUTE OF METALS & COMPOSITES FOR FUTURE INDUSTRIES
YOSHIO MINODA (Research and Development Institut of Metals and Composites for Future Industries, Tokyo, Japan) IN: Composites '86: Recent advances in Japan and the United States; Proceedings of the Third Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 23-25, 1986 . Tokyo, Japan Society for Composite Materials, 1986, p. 475-481. refs

The latest status of a research and development program to develop basic industrial technology for metal matrix composites suitable for aerospace structures in the 1990's is discussed. Findings to date and remaining problems in the three parts of the program are summarized, including the development of graphite/Al and SiC (Nicalon)/Al preformed wires, the development of primary forming technology for them, and related structural or quality evaluation technologies necessary for application to end items. It has been found that both aluminum-infiltrated graphite and SiC (Nicalon) yarn seem to be very useful intermediate material for producing metal matrix composites. Titanium matrix composites show superior mechanical properties compared to aluminum matrix composites. C.D.

A87-52494* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE NASA STRAIN GAGE LABORATORY
HOWARD F. HOBART and HERBERT A. WILL (NASA, Lewis Research Center, Cleveland, OH) IN: Annual Hostile Environments and High Temperature Measurements Conference, 3rd, Cincinnati, OH, Mar. 25, 26, 1986, Proceedings . Bethel, CT, Society for Experimental Mechanics, Inc., 1986, p. 5-9.

The goal of the NASA-sponsored high-temperature high-strain gage program (which combines in-house, contract, and grant work) is to develop a gage that will measure static strains up to 2000 microstrain to within 10 percent, and at temperatures up to 1250 K (typical for combustors and turbine blades and vanes of gas turbine engines) maintained over 50-h period. The basic equipment of the NASA in-house lab is described (with special attention given to the strain-gage testing system), and some examples of recent test results are discussed. Data are presented on following tests performed on four gages: apparent strain vs temperature at different cooling rates, gage factor at various strain and temperature levels, and drift and creep tests at 133 C. I.S.

A87-53082* United Technologies Corp., East Hartford, Conn.
THE HUMAN QUEST IN SPACE; PROCEEDINGS OF THE TWENTY-FOURTH GODDARD MEMORIAL SYMPOSIUM, GREENBELT, MD, MAR. 20, 21, 1986
GERALD L. BURDETT, ED. (United Technologies Corp., Hartford, CT) and GERALD A. SOFFEN, ED. (NASA, Goddard Space Flight Center, Greenbelt, MD) Symposium organized by AAS; Sponsored by AAS, AIAA, National Space Club, and National Space Institute. San Diego, CA, Univelt, Inc. (Science and Technology Series. Volume 65), 1987, 310 p. For individual items see A87-53083 to A87-53093.

Papers are presented on the Space Station, materials processing in space, the status of space remote sensing, the evolution of space infrastructure, and the NASA Teacher Program. Topics discussed include visionary technologies, the effect of intelligent machines on space operations, future information technology, and the role of nuclear power in future space missions. Consideration is given to the role of humans in space exploration; medical problems associated with long-duration space flights; lunar and Martian settlements, and Biosphere II (the closed ecology project). I.F.

A87-53085
PROSPECTS FOR SPACE SCIENCE
CARL SAGAN (Cornell University, Ithaca, NY; Planetary Society, Pasadena, CA) IN: The human quest in space; Proceedings of the Twenty-fourth Goddard Memorial Symposium, Greenbelt, MD, Mar. 20, 21, 1986 . San Diego, CA, Univelt, Inc., 1987, p. 45-51; Discussion, p. 52-55.
(AAS PAPER 86-106)

The use of the space environment for astronomy and the study of the earth is examined. Particular attention is given to the exploration of the electromagnetic spectrum and the solar system. It is argued that it is necessary to complete the proposed missions to rendezvous with a comet and to send an entry probe into the atmosphere of Titan. The need for the development of a Space Station is discussed, and the benefits of manned versus unmanned missions are considered. The political, social, and economic benefits of a joint U.S./Soviet manned mission to Mars are also discussed. I.F.

A87-53086
TECHNOLOGY PROJECTIONS AND SPACE SYSTEMS OPPORTUNITIES FOR THE 2000-2030 TIME PERIOD
ROBERT A. DAVIS (Aerospace Corp., Los Angeles, CA) IN: The human quest in space; Proceedings of the Twenty-fourth Goddard Memorial Symposium, Greenbelt, MD, Mar. 20, 21, 1986 . San Diego, CA, Univelt, Inc., 1987, p. 75-120; Discussion, p. 121-123. refs
(AAS PAPER 86-109)

Some of the space system technologies necessary for civil space projects in the future (2000-2030), which were included in a report prepared for the American Institute of Aeronautics and Astronautics for submittal to the National Space Commission, are described. The effects of NASA and DOD space system technology planning, the SDI program, and National Space Strategy on space systems and technology developments are examined. Space transportation, the establishment of a Space Station, the role of government in space commercialization, international competition in space, joint space missions, and space activities for enhancing global habitability are discussed. Consideration is given to the benefits space systems with earth-oriented applications can provide to civilian communications, navigation and location, earth observation, and space manufacturing; missions to the moon, Mars, comets, asteroids, other planets, and the Galaxy; the next-generation of space transportation systems and mission control; and the construction and maintenance of space infrastructure. I.F.

A87-53091* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
MARTIAN SETTLEMENT
BARNEY B. ROBERTS (NASA, Johnson Space Center, Houston, TX) IN: The human quest in space; Proceedings of the Twenty-fourth Goddard Memorial Symposium, Greenbelt, MD, Mar. 20, 21, 1986 . San Diego, CA, Univelt, Inc., 1987, p. 227-235; Discussion, p. 236, 237.
(AAS PAPER 86-117)

The rationale for a manned Mars mission and the establishment of a base is divided into three areas: science, resource utilization, and strategic issues. The effects of a Mars mission on the objectives of near-term NASA programs, and the applications of these programs to a Mars mission are examined. The use of extraterrestrial resources to supply space settlements and thereby reduce transportation costs is studied; the development of systems for extraterrestrial materials processing will need to be researched. The possibility of a joint U.S./Soviet Mars mission is discussed by the symposium participants. I.F.

A87-53147* National Aeronautics and Space Administration, Washington, D.C.
NASA'S PLANS TO OBSERVE THE EARTH'S ATMOSPHERE WITH LIDAR
ROBERT J. CURRAN (NASA, Washington, DC) IN: IGARSS '87 - International Geoscience and Remote Sensing Symposium, Ann Arbor, MI, May 18-21, 1987, Digest. Volume 1 . New York, Institute of Electrical and Electronics Engineers, Inc., 1987, p. 379, 380.

The development of two active laser remote-sensing systems designed for the Earth Observing System (EOS) as part of the Space Station for the 1990s is discussed. The operational capabilities of lidar in the Lidar Atmospheric Sounder and Altimeter (LASA) are considered, and the synergistic use of LASA and EOS data, as in the combination of LASA-determined vertical profiles of water vapor and two-dimensional EOS depictions of water vapor distribution, is emphasized. The Laser Atmospheric Wind Sounder will measure wind profiles with an accuracy of a few meters per second, and will provide samples at intervals of about 100 km horizontally for layers 1 km thick. R.R.

A87-53676
ADVANCES IN NUCLEAR ASTROPHYSICS; PROCEEDINGS OF THE SECOND IAP WORKSHOP, PARIS, FRANCE, JULY 7-11, 1986
ELISABETH VANGIONI-FLAM, ED., JEAN AUDOUZE, ED. (CNRS, Institut d'Astrophysique, Paris, France), MICHEL CASSE, ED. (CEA, Centre d'Etudes Nucleaires de Saclay Gif-sur-Yvette, France), JEAN-PIERRE CHIEZE, ED. (CEA, Bruyeres-le-Chatel, France), and J. TRAN THANH VAN, ED. (Paris XI, Universite, Orsay, France) Workshop sponsored by CNRS. Gif-sur-Yvette, France, Editions Frontieres, 1986, 622 p. For individual items see A87-53677 to A87-53728.

Topics discussed include early nucleosynthesis; solar neutrinos; nucleosynthesis and stellar evolution; explosive nucleosynthesis in novae, supernovae, and related objects; and nuclear gamma-ray lines. Attention is also given to nucleosynthesis of heavy nuclei, nucleocosmochronology and galactic evolution, and the determination of nuclear parameters. B.J.

A87-53742
THE FUTURE GENERATION OF RESOURCES SATELLITES
CAESAR VOUTE (International Institute for Aerospace Survey and Earth Sciences, Enschede, Netherlands) ITC Journal (ISSN 0303-2434), no. 4, 1986, p. 307-317. refs

Current trends in remote sensing are considered. A number of national and regional satellite remote sensing programs and projects are described. The requirements for remote sensing and the distribution of the data are discussed. The commercialization of remote sensing systems and images is examined. I.F.

A87-53914#
THE SOLAR-TERRESTRIAL SCIENCE PROGRAMME
K.-P. WENZEL, V. DOMINGO, and R. SCHMIDT (ESA, Space Science Dept., Noordwijk, Netherlands) ESA Bulletin (ISSN 0376-4265), no. 50, May 1987, p. 8-16.

The Solar-Terrestrial Science Program which is a joint program between NASA and ESA is described. The program consists of two missions: Soho, the solar and heliospheric observatory, and Cluster, a four spacecraft space-plasma-physics mission. The objectives, spacecraft design, orbit, and operations of the Soho and Cluster missions are discussed. The ground-based handling and dissemination of the data from the two missions are examined. I.F.

A87-53991
THE ASTRONAUT AND THE ROBOT - SHORT- AND LONG-TERM SCENARIOS FOR SPACE TECHNOLOGY
ANDRE LEBEAU (Conservatoire National des'Arts et Metiers, Paris, France) (Futuribles, Sept. 1986) Space Policy (ISSN 0265-9646), vol. 3, Aug. 1987, p. 207-220.

The prospects for space technology over the next decades are assessed, contrasting the slowing growth of 'conventional' space activities (communications, remote sensing, or collection of scientific data) with the potential of new-generation manned systems (the Space Station, Mir/Salyut, and Hermes). The short-term military (ABM/SDI) and civilian (materials processing) applications of such systems are considered, but the need for a long-term global strategy aimed at freeing technology from the limitations of the biosphere is stressed. It is suggested that advances in robotics could reduce the number of human interventions required to meet these goals. Increased privatization of mature technologies and intense efforts to mobilize public opinion are recommended. Also included are critical examinations of (1) the current technological and competitive status of U.S. and European launch vehicles and (2) the arguments used by some space scientists against the emphasis on manned programs. T.K.

A87-53992
THE EXPORT OF SPACE TECHNOLOGY - PROSPECTS AND DANGERS
STEPHAN F. VON WELCK (Deutsche Gesellschaft fuer Auswaertige, Politik, Bonn, West Germany) Space Policy (ISSN 0265-9646), vol. 3, Aug. 1987, p. 221-231. Research supported by the Fritz Thyssen Foundation. refs

Economic, political, and legal aspects of the export of missile and space technology (ST) from the U.S., Europe, Japan, and the USSR to other nations are discussed. Topics addressed include the growing markets for both civilian and military space systems and services, governmental support for ST export, European and Japanese reactions to past U.S. policies aimed at maintaining a near-monopoly on space services, national-security conflicts arising from the dual-use nature of ST, and national and international export controls. The impact of the 'Guidelines for Sensitive Missile-Relevant Transfers' published by the U.S. government in April 1987 is considered in detail. T.K.

A87-54198
DEVELOPING SPACE STATION. II - POWER, RENDEZVOUS, DOCKING AND REMOTE SENSING ARE IMPORTANT ELEMENTS OF THE SPACE STATION
ROY HATHAWAY Space (ISSN 0267-954X), vol. 3, July-Aug. 1987, p. 35-37, 48.

Some systems and applications for the proposed Space Station are considered. The use of GaAs cells in the solar power systems for the Space Station is examined; the fabrication, characteristics, and costs of GaAs solar cells are described. Rendezvous and docking capabilities are required for the Space Station to function as a polar platform; a monopulse tracking radar is being evaluated as the docking system for the Station. The benefits the Space Station, operating as a polar platform, can provide to remote sensing, in particular meteorology, environmental research, and solar terrestrial physics, are discussed. I.F.

N87-10812*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE CASE FOR MARS: CONCEPT DEVELOPMENT FOR A MARS RESEARCH STATION
S. M. WELCH, ed. and C. R. STOKER, ed. 15 Apr. 1986
139 p
(Contract NAS7-918)
(NASA-CR-179753; JPL-PUB-86-28; NAS 1.26:179753) Avail: NTIS HC A07/MF A01 CSCL 03B

A program to establish a permanent scientific research base on Mars is described. A Mars base as the much needed long-term focus for the space program is presented. A permanent base was chosen rather than the more conventional concept of a series of individual missions to different sites because the permanent base offers much greater scientific return plus greater crew safety and the potential for eventual growth into a settlement. The Mars base will strive for self-sufficiency and autonomy from Earth. Martian resources will be used to provide life support materials and consumables. The Martian atmosphere will provide a convenient source of volatiles: CO2, N2, and water. Rocket propellant (for returning vehicles), fuels, breathable air, and fertilizers will be manufactured from Mars air. Food will be grown on Mars using

Martian materials as plant nutrients. A permanent human presence will be maintained on Mars beginning with the first manned landing via a strategy of crew overlap. This permanent presence will ensure safety and reliability of systems through continuous tending, maintenance, and expansion of the base's equipment and systems. A permanent base will allow the development of a substantial facility on Mars for the same cost (in terms of Earth departure mass) as a series of temporary camps. A base equipped with surface rovers, airplanes, and the ability to manufacture consumables and return propellant will allow far more extensive planetary exploration over a given period of years than would approaches featuring a series of short exploration missions such as the Apollo Moon program. Author

N87-11478*# Management and Technical Services Co., Washington, D.C.
USSR SPACE LIFE SCIENCES DIGEST, ISSUE 8
L. R. HOOKE, ed., M. RADTKE, ed., V. GARSHNEK, ed., R. TEETER, ed., and J. E. ROWE, ed. (Library of Congress, Washington, D. C.) Oct. 1985 111 p
(Contract NASW-3676)
(NASA-CR-3922(09); NAS 1.26:3922(09)) Avail: NTIS HC A06/MF A01 CSCL 06C

This is the eighth issue of NASA's USSR Space Life Sciences Digest. It contains abstracts of 48 papers recently published in Russian language periodicals and bound collections and of 10 new Soviet monographs. Selected abstracts are illustrated with figures and tables. Additional features include reviews of two Russian books on radiobiology and a description of the latest meeting of an international working group on remote sensing of the Earth. Information about English translations of Soviet materials available to readers is provided. The topics covered in this issue have been identified as relevant to 33 areas of aerospace medicine and space biology. These areas are: adaptation, biological rhythms, biospherics, body fluids, botany, cardiovascular and respiratory systems, cosmonaut training, cytology, endocrinology, enzymology, equipment and instrumentation, exobiology, gastrointestinal system, genetics, group dynamics, habitability and environment effects, hematology, human performance, immunology, life support systems, man-machine systems, mathematical modeling, metabolism, microbiology, musculoskeletal system, neurophysiology, nutrition, operational medicine, personnel selection, psychology, reproductive biology, and space biology and medicine. Author

N87-11809 Joint Publications Research Service, Arlington, Va.
USSR REPORT: SPACE
12 Sep. 1986 226 p Transl. into ENGLISH from various Russian articles
(JPRS-USP-86-005) Avail: NTIS HC A11/MF A01

Topics addressed include: manned mission highlights; space sciences; interplanetary sciences; life sciences; aerospace engineering; space applications; space policy and administration; and launch table.

N87-12530*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
RESEARCH AND TECHNOLOGY Annual Report, 1985
Jan. 1986 138 p
(NASA-TM-86852; A-85045; NAS 1.15:86852) Avail: NTIS HC A07/MF A01 CSCL 05A

This report describes various research and technology activities at Ames Moffett and Ames Dryden. Highlights of these accomplishments indicate the Center's varied and highly productive research efforts for 1985. Author

N87-12531*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RESEARCH AND TECHNOLOGY, 1986 Annual Report
1986 113 p
(NASA-TM-89037; NAS 1.15:89037) Avail: NTIS HC A06/MF A01 CSCL 05A

The mission of the NASA Langley Research Center is to increase the knowledge and capability of the United States in a full range of aeronautics disciplines and in selected space disciplines. This mission will be accomplished by: performing innovative research relevant to national needs and Agency goals; transferring technology to users in a timely manner; and providing development support to other United States Government agencies, industry, and the NASA centers. This report contains highlights of the major accomplishments and applications made during the past year. The highlights illustrate both the broad range of the research and technology activities at the NASA Langley Research Center and the contributions of this work toward maintaining United States leadership in aeronautics and space research. Author

N87-12995# Executive Office of the President, Washington, D. C. Office of Science and Technology Policy.
EARTH SCIENCES RESEARCH IN THE CIVIL SPACE PROGRAM
Oct. 1985 42 p
(PB86-232014) Avail: NTIS HC A03/MF A01 CSCL 22A

The report has been prepared in response to the President's National Space Strategy Directive to the Office of Science and Technology Policy to review and define the goals and missions of the various agencies in the area of Earth Science research. GRA

N87-13351# Army Field Artillery School, Fort Sill, Okla. Library Div.
GOVERNMENT LIBRARIES. A PERIODICALS BIBLIOGRAPHY, TOGETHER WITH LIST OF BIBLIOGRAPHIES AND INDEXES Final Report
L. L. MILLER, JR. 4 Jul. 1986 21 p
(AD-A169422; USAFAS/MSTLD/SB116) Avail: NTIS HC A02/MF A01 CSCL 05B

This two part number presents research on government libraries, here and aboard. The second portion consists of a bio-bibliography on bibliographies and indexes compiled by the Morris Swett Technical Library staff. GRA

N87-15028# Committee on Commerce, Science, and Transportation (U.S. Senate).
REPORT OF THE NATIONAL COMMISSION ON SPACE
Washington GPO 1986 53 p Hearing before the Subcommittee on Science, Technology and Space of the Committee on Commerce, Science and Transportation, 99th Congress, 2nd Session, 22 Jul. 1986
(S-HRG-99-954; GPO-64-727) Avail: Subcommittee on Science, Technology and Space

The proposed agenda for the civilian space program for the next 20 years and beyond was discussed. The National Commission on Space proposed a broad, long-range, pioneering mission which includes: exploration and development of the space frontier; advancing science, technology, and enterprise; and building institutions and systems that make acessible vast resources and support human settlement beyond Earth orbit, from the highlands of the Moon to the plains of Mars. To accomplish this mission, three mutually-supportive thrusts are outlined: advancing scientific understanding of the planet Earth, the solar system, and the universe; exploring, prospecting, and settling the solar system; and stimulating space enterprise. B.G.

N87-15034*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RESEARCH AND TECHNOLOGY, FISCAL YEAR 1986, MARSHALL SPACE FLIGHT CENTER Annual Report
Nov. 1986 138 p
(NASA-TM-86567; NAS 1.15:86567) Avail: NTIS HC A07/MF A01 CSCL 05A

The Marshall Space Flight Center is continuing its vigorous efforts in space-related research and technology. Extensive activities in advanced studies have led to the approval of the Orbital Maneuvering Vehicle as a new start. Significant progress was made in definition studies of liquid rocket engine systems for future space transportation needs and the conceptualization of advanced laucnch vehicles. The space systems definition studies have brought the Advanced X-ray Astrophysics Facility and Gravity Probe-B to a high degree of maturity. Both are ready for project implementation. Also discussed include significant advances in low gravity sciences, solar terrestrial physics, high energy astrophysics, atmospheric sciences, propulsion systems, and on the critical element of the Space Shuttle Main Engine in particular. The goals of improving the productivity of high-cost repetitive operations on reusable transportation systems, and extending the useful life of such systems are examined. The research and technology highlighted provides a foundation for progress on the Hubble Space Telescope, the Space Station, all elements of the Space Transportation System, and the many other projects assigned to this Center. Author

N87-15239* National Aeronautics and Space Administration, Washington, D.C.
TECHNOLOGY FOR LARGE SPACE SYSTEMS: A BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 15)
Jan. 1987 161 p
(NASA-SP-7046(15); NAS 1.21:7046(15)) Avail: NTIS HC A08 CSCL 22A

This bibliography lists 594 reports, articles and other documents introduced into the NASA scientific and technical information system between January 1, 1986 and June 30, 1986. Its purpose is to provide helpful information to the researcher, manager, and designer in technology development and mission design according to system, interactive analysis and design, structural and thermal analysis and design, structural concepts and control systems, electronics, advanced materials, assembly concepts, propulsion, and solar power satellite systems. Author

N87-15320*# Wyle Labs., Inc., Huntsville, Ala.
EQUIPMENT CONCEPT DESIGN AND DEVELOPMENT PLANS FOR MICROGRAVITY SCIENCE AND APPLICATIONS RESEARCH ON SPACE STATION: COMBUSTION TUNNEL, LASER DIAGNOSTIC SYSTEM, ADVANCED MODULAR FURNACE, INTEGRATED ELECTRONICS LABORATORY
M. L. UHRAN, W. W. YOUNGBLOOD, T. GEORGEKUTTY, M. R. FISKE, and W. O. WEAR Sep. 1986 260 p
(Contract NAS3-24654)
(NASA-CR-179535; NAS 1.26:179535) Avail: NTIS HC A12/MF A01 CSCL 22A

Taking advantage of the microgravity environment of space NASA has initiated the preliminary design of a permanently manned space station that will support technological advances in process science and stimulate the development of new and improved materials having applications across the commercial spectrum. Previous studies have been performed to define from the researcher's perspective, the requirements for laboratory equipment to accommodate microgravity experiments on the space station. Functional requirements for the identified experimental apparatus and support equipment were determined. From these hardware requirements, several items were selected for concept designs and subsequent formulation of development plans. This report documents the concept designs and development plans for two items of experiment apparatus - the Combustion Tunnel and the Advanced Modular Furnace, and two items of support equipment the Laser Diagnostic System and the Integrated Electronics Laboratory. For each concept design, key technology developments were identified that are required to enable or enhance the development of the respective hardware. Author

N87-15678*# National Aeronautics and Space Administration, Washington, D.C.
REFERENCE MISSION OPERATIONAL ANALYSIS DOCUMENT (RMOAD) FOR THE LIFE SCIENCES RESEARCH FACILITIES
Jan. 1987 215 p
(NASA-TM-89604; NAS 1.15:89604) Avail: NTIS HC A10/MF A01 CSCL 06C

The space station will be constructed during the next decade as an orbiting, low-gravity, permanent facility. The facility will provide a multitude of research opportunities for many different users. The pressurized research laboratory will allow life scientists to study the effects of long-term exposure to microgravity on humans, animals, and plants. The results of these studies will increase our understanding of this foreign environment on basic life processes and ensure the safety of man's long-term presence in space. This document establishes initial operational requirements for the use of the Life Sciences Research Facility (LSRF) during its construction. Author

N87-16742*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RESEARCH REPORTS: 1986 NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM
L. MICHAEL FREEMAN, ed., FRIDTJOF A. SPEER, ed., ERNESTINE K. COTHRAN, ed., and GERALD R. KARR, ed. Nov. 1986 1022 p Program held in Huntsville, Ala., 27 May - 1 Aug. 1986 Prepared in cooperation with Alabama Univ., Huntsville and Alabama Univ., Tuscaloosa
(Contract NGT-01-002-099)
(NASA-CR-178966; NAS 1.26:178966) Avail: NTIS HC A99/MF E04 CSCL 05A

For the 22th consecutive year, a NASA/ASEE Summer Faculty Fellowship Program was conducted for the summer of 1986 by the University of Alabama and Marshall Space Flight Center. The basic objectives of the program are: (1)to further the professional knowledge of qualified engineering and science faculty members; (2)to stimulate an exchange of ideas between participants and NASA; (3)to enrich and refresh the research and teaching activities of the participants' institution; and (4)to contribute to the research objectives of the NASA center. The Faculty Fellows spent ten weeks at MSFC engaged in a research project compatible with their interest and background and worked in collaboration with a NASA/MSFC colleague. This is a compilation of Fellows' reports on their research.

N87-16749*# Alabama Univ., Huntsville. Dept. of Industrial Engineering.
OPERATIONS PLANNING AND ANALYSIS HANDBOOK FOR NASA/MSFC PHASE B DEVELOPMENT PROJECTS
ROBERT C. BATSON *In* NASA. Marshall Space Flight Center Research Reports: 1986 NASA/ASEE Summer FAculty Fellowship Program 26 p Nov. 1986
Avail: NTIS HC A99/MF E04 CSCL 05A

Current operations planning and analysis practices on NASA/MSFC Phase B projects were investigated with the objectives of (1) formalizing these practices into a handbook and (2) suggesting improvements. The study focused on how Science and Engineering (S&E) Operational Personnel support Program Development (PD) Task Teams. The intimate relationship between systems engineering and operations analysis was examined. Methods identified for use by operations analysts during Phase B include functional analysis, interface analysis methods to calculate/allocate such criteria as reliability, Maintainability, and operations and support cost. Author

N87-16802*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPENDIUM OF NASA LANGLEY REPORTS ON HYPERSONIC AERODYNAMICS
FRANCES E. SABO, AUBREY M. CARY, and SHIRLEY W. LAWSON Jan. 1987 177 p
(NASA-TM-87760; NAS 1.15:87760) Avail: NTIS HC A09/MF A01 CSCL 01A

Reference is made to papers published by the Langley Research Center in various areas of hypersonic aerodynamics for the period 1950 to 1986. The research work was performed either in-house by the Center staff or by other personnel supported entirely or in part by grants or contracts. Abstracts have been included with the references when available. The references are listed chronologically and are grouped under the following general headings: (1) Aerodynamic Measurements - Single Shapes; (2) Aerodynamic Measurements - Configurations; (3) Aero-Heating; (4) Configuration Studies; (5) Propulsion Integration Experiment; (6) Propulsion Integration - Study; (7) Analysis Methods; (8) Test Techniques; and (9) Airframe Active Cooling Systems. Author

N87-17531*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SCIENTIFIC AND TECHNICAL INFORMATION OUTPUT OF THE LANGLEY RESEARCH CENTER FOR CALENDAR YEAR 1986
Jan. 1987 265 p
(NASA-TM-89065; NAS 1.15:89065) Avail: NTIS HC A12/MF A01 CSCL 05B

This document is a compilation of the scientific and technical information that the Langley Research Center has produced during the calendar year 1986. Included are citations for Formal Reports, Quick-Release Technical Memorandums, Contractor Reports, Journal Articles and Other Publications, Meeting Presentations, Technncial Talks, Computer Programs, Tech Briefs, and Patents. Author

N87-17532*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FY 1986 SCIENTIFIC AND TECHNICAL REPORTS, ARTICLES, PAPERS AND PRESENTATIONS
JOYCE E. TURNER, comp. Oct. 1986 72 p
(NASA-TM-86575; NAS 1.15:86575) Avail: NTIS HC A04/MF A01 CSCL 05B

Formal NASA technical reports, papers published in technical journals, and presentations by Marshall Space Flight Center (MSFC) personnel in FY-86 are presented. Also included are papers of MSFC contractors. Author

N87-17656*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RESEARCH AND TECHNOLOGY Annual Report, 1986
1986 103 p
(NASA-TM-88868; NAS 1.15:88868) Avail: NTIS HC A06/MF A01 CSCL 05A

The research and technology accomplishments of the NASA Lewis Research Center are summarized for the fiscal year 1986, the 45th anniversary year of the Center. Five major sections are presented covering: aeronautics, aerospace technology, space communications, space station systems, and computational technology support. A table of contents by subjects was developed to assist the reader in finding articles of special interest. Author

N87-17934*# National Aeronautics and Space Administration, Washington, D.C.
MICROGRAVITY SCIENCE AND APPLICATIONS BIBLIOGRAPHY, 1986 REVISION
1987 84 p
(NASA-TM-89608; NAS 1.15:89608) Avail: NTIS HC A05/MF A01 CSCL 22A

This edition of the Microgravity Science and Applications (MSA) Bibliography is a compilation of Government reports, contractor reports, conference proceedings, and journal articles dealing with flight experiments utilizing a low-gravity environment to elucidate and control various processes or ground-based activities providing supporting research. It encompasses literature published in FY-86 and part of FY-87 but not cited in the 1985 Revision, pending publications, and those submitted for publication during this time period. Subdivisions of the bibliography include six major categories: Electronic Materials, Metals, Alloys, and Combustion Science. Other categories include Experimental Technology and General Studies. Included are publications from the European and Soviet programs. In addition, there is a list of patents and a cross reference index. Author

N87-17935*# National Aeronautics and Space Administration, Washington, D.C.
MICROGRAVITY SCIENCE AND APPLICATIONS PROGRAM TASKS
Feb. 1987 275 p
(Contract NASW-4174)
(NASA-TM-89607; NAS 1.15:89607) Avail: NTIS HC A12/MF A01 CSCL 07D

The Microgravity Science and Applications (MSA) program is directed toward research in the science and technology of processing materials under conditions of low gravity to provide a detailed examination of the constraints imposed by gravitational forces on Earth. The program is expected to lead to the development of new materials and processes in commercial applications adding to this nation's technological base. The research studies emphasize the selected materials and processes that will best elucidate the limitations due to gravity and demonstrate the enhanced sensitivity of control of processes that may be provided by the weightless environment of space. Primary effort is devoted to a study of the specific areas of research which reveals potential value in the initial investigations of the previous decades. Examples of previous process research include crystal growth and directional solidification of metals; containerless processing of reactive materials; synthesis and separation of biological materials; etc. Additional efforts will be devoted to identifying the special requirements which drive the design of hardware to reduce risk in future developments. E.R.

N87-18152# Geological Survey, Reston, Va.
THE USE OF SPACE TECHNOLOGY IN FEDERALLY FUNDED LAND PROCESSES RESEARCH IN THE UNITED STATES
G. A. THORLEY and R. MCARDLE (Department of Agriculture, Washington, D.C.) *In* ESA Proceedings of the 1986 International Geoscience and Remote Sensing Symposium (IGARSS '86) on Remote Sensing: Today's Solutions for Tomorrow's Information Needs, Volume 3 p 1267-1272 Aug. 1986
Avail: NTIS HC A21/MF A01; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

The use of space technology in federally funded Earth science research in the United States was reviewed. Government departments and independent agencies, representing the primary Earth science research agencies in the Federal government, participated in the review: NASA, NOAA, Department of the Interior, Department of Agriculture, Department of Energy, U.S. Army Corps of Engineers, Agency for International Development, National Science Foundation, and Environmental Protection Agency. The review indicates that, while there is considerable overlap in the legislated missions of the Earth science agencies, most of the space-related land processes research is complementary. ESA

N87-18300*# National Aeronautics and Space Administration, Washington, D.C.
THE 1985-86 NASA SPACE/GRAVITATIONAL BIOLOGY ACCOMPLISHMENTS
Feb. 1987 176 p Prepared in cooperation with George Washington Univ., Washington, D.C.
(Contract NASW-3165)
(NASA-TM-89809; NAS 1.15:89809) Avail: NTIS HC A09/MF A01 CSCL 06C

Individual Technical summaries of research projects of NASA's Space/Gravitational Biology Program are presented. This Program is concerned with using the unique characteristics of the space

environment, particularly microgravity, as a tool to advance knowledge in the biological sciences; understanding how gravity has shaped and affected life on Earth; and understanding how the space environment affects both plant and animal species. The summaries for each project include a description of the research, a listing of the accomplishments, an explanation of the significance of the accomplishments, and a list of publications.
Author

N87-18907*# California Univ., Santa Barbara. Information Sciences Research Group.
REMOTE SENSING INFORMATION SCIENCES RESEARCH GROUP, YEAR FOUR
JOHN E. ESTES, TERENCE SMITH, and JEFFREY L. STAR 1 Jan. 1987 140 p
(Contract NAGW-455)
(NASA-CR-180198; NAS 1.26:180198) Avail: NTIS HC A07/MF A01 CSCL 05B

The needs of the remote sensing research and application community which will be served by the Earth Observing System (EOS) and space station, including associated polar and co-orbiting platforms are examined. Research conducted was used to extend and expand existing remote sensing research activities in the areas of georeferenced information systems, machine assisted information extraction from image data, artificial intelligence, and vegetation analysis and modeling. Projects are discussed in detail.
B.G.

N87-19322*# National Aeronautics and Space Administration, Washington, D.C.
STATUS AND FUTURE OF LUNAR GEOSCIENCE
1986 63 p
(NASA-SP-484; NAS 1.21:484) Avail: SOD HC $4.25 as 033-000-00997-6; NTIS MF A01 CSCL 03B

The Moon is of special interest among the many and diverse bodies of the solar system because it serves as a scientific baseline for understanding the terrestrial planets, its origin is closely tied to the early history of the Earth, and its proximity permits a variety of space applications such as mining and establishment of bases and colonies. Data acquisition and analysis have enabled advances to be made and the remaining questions in many fields of lunar geoscience to be identified. The status and unresolved problems of lunar science are discussed. Immediate needs, new unmanned missions, and a return to the Moon (a lunar base) are examined.
B.G.

N87-20061*# National Aeronautics and Space Administration, Washington, D.C.
NASA OAST AND ITS ROLE IN SPACE TECHNOLOGY DEVELOPMENT
J. ROMERO *In* JPL, Space Technology Plasma Issues in 2001 p 29-37 1 Oct. 1986
Avail: NTIS HC A20/MF A01 CSCL 12B

Several new programs, efforts in space research and technology, are introduced that the Office of Aeronautics and Space Technology has begun to support. The four key issues that currently are consuming NASA's energies and should be of great concern are listed. NASA is placing its emphasis in space on: (1) reconstituting the Shuttle capability; (2) maintaining the space station momentum; (3) resolving the current science mission backlog; and (4) rebuilding the technology base. Ways of implementing and funding these issues are discussed.
E.R.

N87-20314*# Utah State Univ., Logan. Center for Atmospheric and Space Sciences.
A SYSTEMS-LEVEL PERFORMANCE HISTORY OF GET AWAY SPECIALS AFTER 25 SPACE SHUTTLE MISSIONS
REX W. RIDENOURE *In* NASA. Goddard Space Flight Center The 1986 Get Away Special Experimenter's Symposium p 79-86 Feb. 1987
Avail: NTIS HC A11/MF A01 CSCL 22A

Summarized are the results of a thorough performance study of Get Away Special (GAS) payloads conducted in 1986. During the study, a complete list of standard and non-standard GAS payloads vs. Shuttle mission was constructed, including specific titles for the experiments in each canister. A broad data base for each canister and each experiment was then compiled. Performance results were then obtained for all but a few experiments. The canisters and experiments were subsequently categorized according to the degree of experiment success. For those experiments experiencing failures or anomalies, several correlations and generalizations were extracted from individual subsystem performance data. Recommendations are made which may enhance the success and performance of future GAS payloads.
Author

N87-20320*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HITCHHIKER-G: A NEW CARRIER SYSTEM FOR ATTACHED SHUTTLE PAYLOADS
T. C. GOLDSMITH *In its* The 1986 Get Away Special Experimenter's Symposium p 127-134 Feb. 1987
Avail: NTIS HC A11/MF A01 CSCL 22B

A new carrier system has been developed for economical and quick response flight of small attached payloads on the space shuttle. Hitchhiker-G can accommodate up to 750 lb. of customer payloads in canisters or mounted to an exposed plate. The carrier connects to the orbiter's electrical systems and provides up to six customers with standard electrical services including power, real time telemetry, and commands. A transparent data and command system concept is employed to allow the customer to easily use his own ground support equipment and personnel to control his payload during integration and flight operations. The first Hitchhiker-G was successfully flown in January 1986 on STS 61C.
Author

N87-20568*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE STATION STRUCTURES AND DYNAMICS TEST PROGRAM
CARLETON J. MOORE, JOHN S. TOWNSEND, and EDWARD W. IVEY Mar. 1987 47 p
(NASA-TP-2710; NAS 1.60:2710) Avail: NTIS HC A03/MF A01 CSCL 20K

The design, construction, and operation of a low-Earth orbit space station poses unique challenges for development and implementation of new technology. The technology arises from the special requirement that the station be built and constructed to function in a weightless environment, where static loads are minimal and secondary to system dynamics and control problems. One specific challenge confronting NASA is the development of a dynamics test program for: (1) defining space station design requirements, and (2) identifying the characterizing phenomena affecting the station's design and development. A general definition of the space station dynamic test program, as proposed by MSFC, forms the subject of this report. The test proposal is a comprehensive structural dynamics program to be launched in support of the space station. The test program will help to define the key issues and/or problems inherent to large space structure analysis, design, and testing. Development of a parametric data base and verification of the math models and analytical analysis tools necessary for engineering support of the station's design, construction, and operation provide the impetus for the dynamics test program. The philosophy is to integrate dynamics into the design phase through extensive ground testing and analytical ground simulations of generic systems, prototype elements, and subassemblies. On-orbit testing of the station will also be used to define its capability.
Author

N87-20835# East Carolina Univ., Greenville, N.C. Dept. of Mathematics.
A STOCHASTIC APPROACH TO PROJECT PLANNING IN AN R AND D ENVIRONMENT Final Report
S. J. SEYEDGHASEMIPOUR Feb. 1987 105 p
(Contract DE-AS19-84BC-10828)
(DE87-005347; DOE/BC-10828/2) Avail: NTIS HC A06/MF A01

This study describes a simulation approach to project planning in an R and D environment by network model. GERT (Graphical Evaluation and Review Technique), a network model, was utilized for the modeling of a hypothetical research and development project. GERT is a network model capable of including randomness in activity duration, probabilistic branching, feedback loop, and multiple terminate node in a project planning. These capabilities make it more suitable for modeling of research and development projects than the previous approaches such as CPM and PERT. SLAM II simulation language is utilized for simulation of the network model. SLAM II is a simulation language which heavily relies on GASP IV and Q-GERTS with powerful modeling capability in a single integrated framework. The simulation is performed on a hypothetical standard research and development project. Two cases of project planning are considered. In the first case, the traditional simulation of network model of the hypothetical R and D project is performed. In the second case, learning factor is incorporated in the simulation process. Learning factor, in the context of project planning, means the mean and variance of a probability distribution representing an activity duration is discounted (reduced) every time that activity is repeated. The results and statistics of each case study concerning expected duration of successful completion of the project, probability of washouts, and realization time of milestones are presented in details. The differences between two cases (i.e., with and without learning factor) are discussed. DOE

N87-20836# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
ACTIVITIES REPORT IN AEROSPACE RESEARCH Annual Report, 1985
Sep. 1986 17 p
(ETN-87-99378) Avail: NTIS HC A02/MF A01

The management and administration, organization, operational departments, and patents of the French national aerospace research administration are described. ESA

N87-21157*# McDonnell-Douglas Corp., St. Louis, Mo.
SHUTTLE GET-AWAY SPECIAL EXPERIMENTS
GEORGE ORTON *In* NASA. Lewis Research Center Microgravity Fluid Management Symposium p 201-216 Apr. 1987
Avail: NTIS HC A10/MF A01 CSCL 22A

This presentation describes two shuttle Get-Away-Special (GAS) experiments built by McDonnell Douglas to investigate low-g propellant acquisition and gaging. The first experiment was flown on shuttle mission 41-G in October 1984. The second experiment has been qualified for flight and is waiting for a flight assignment. The tests performed to qualify these experiments for flight are described, and the lessons learned which can be applied to future GAS experiments are discussed. Finally, survey results from 134 GAS experiments flown to date are presented. On the basis of these results it is recommended that future GAS experiments be qualified to shuttle thermal and dynamic environments through a rigorous series of mission operating tests. Furthermore, should automatic activation of the experiment be required during the boost phase of the mission, NASA-supplied redundant barometric switches should be employed to trigger the activation. Author

N87-21736* National Aeronautics and Space Administration, Washington, D.C.
UNIVERSITY PROGRAM MANAGEMENT INFORMATION SYSTEM, FISCAL YEAR 1986.
1986 390 p
(PB87-127379) Avail: NTIS HC $34.00 CSCL 05B

The University Program Report provides current information and related statistics for approximately 4300 grants/contracts/cooperative agreements active during the report period. NASA Field centers and certain Headquarters Program Offices provide funds for those R&D activities in universities which contribute to the mission needs for that particular NASA element. This annual report is one means of documenting the NASA-university relationship, frequently denoted, collectively, as NASA's University Program. Author

N87-21746# Oklahoma Univ., Norman. Science and Public Policy Program.
IMPROVING THE TRANSFER AND USE OF SCIENTIFIC AND TECHNICAL INFORMATION: THE FEDERAL ROLE. VOLUME 1: SUMMARY AND CONCLUSIONS Final Report
S. BALLARD, C. R. MCCLURE, T. I. ADAMS, M. D. DEVINE, and L. ELLISON Sep. 1986 34 p Sponsored by the National Science Foundation
(PB87-142915) Avail: NTIS HC A03/MF A01 CSCL 05A

Investigated was the transfer and use of federally-supported scientific and technical information (STI) to improve the innovation capacity of private sector firms and their international economic competitiveness. Scientific and Technical Information is defined as the product of research and development. The project specifically addressed the products of federally-supported research and development for civilian purposes. While the potential for spin-offs from the defense R and D system is addressed briefly, a comprehensive review of the system is beyond the scope of the study. Three reports have been produced. Volume 1 summarizes key findings related to the information transfer and use process, identifies positive trends in technology development, and draws several conclusions related to the responsibilities of the Federal government and the private sector. GRA

N87-21747# Oklahoma Univ., Norman. Science and Public Policy Program.
IMPROVING THE TRANSFER AND USE OF SCIENTIFIC AND TECHNICAL INFORMATION: THE FEDERAL ROLE. VOLUME 2: PROBLEMS AND ISSUES IN THE TRANSFER AND USE OF STI Final Report
S. BALLARD, C. R. MCCLURE, T. I. ADAMS, M. D. DEVINE, and L. ELLISON Nov. 1986 184 p Sponsored by the National Science Foundation
(PB87-142923) Avail: NTIS HC A09/MF A01 CSCL 05A

The project investigated the transfer and use of federally-supported scientific and technical information (STI) to improve the innovation capacity of private sector firms and their international economic competitiveness. Scientific and Technical Information is defined as the product of research and development. The project specifically addresses the products of federally-supported research and development for civilian purposes. While the potential for spin-offs from the defense R&D system is addressed briefly, a comprehensive review of the system is beyond the scope of the study. Three reports have been produced. Volume 2 identifies current programs, activities, and trends which determine the availability and value of R&D for the innovation process. Volume 2 also provides the supporting documentation for the conclusions presented here and in Volume 1 regarding the capacity of the U.S. to use its vast R&D resources for improving technological innovation. GRA

N87-21972# Joint Publications Research Service, Arlington, Va.
USSR REPORT: SPACE
19 Feb. 1987 243 p Transl. into ENGLISH from various Russian articles
(JPRS-USP-87-001) Avail: NTIS HC A11/MF A01

Topics addressed include: manned mission highlights; space sciences; interplanetary sciences; life sciences; space engineering; space applications; space policy and administration; and launch schedule.

N87-21996*# California State Univ., Northridge.
SOVIET SPACE STATIONS AS ANALOGS, SECOND EDITION
B. J. BLUTH and MARTHA HELPPIE Aug. 1986 576 p
(Contract NAGW-659)
(NASA-CR-180920; NAS 1.26:180920) Avail: NTIS HC A25/MF A01 CSCL 22B

The available literature that discusses the various aspects of the Soviet Salyut 6 and Salyut 7 space staions are examined as related to human productivity. The methodology for this analog was a search of unclassified literature. Additional information was obtained in interviews with the cosmonauts and some Soviet space personnel. Topics include: general layout and design of the spacecraft system; cosmonauts role in maintenance and repair; general layout and design of the Mir complex; effects of the environment on personnel; information and computer systems; organization systems; personality systems; and physical conditin of the cosmonaut. B.G.

N87-22103*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACELAB 3 MISSION SCIENCE REVIEW
GEORGE H. FICHTL, ed., JOHN S. THEON, ed. (National Aeronautics and Space Administration, Washington, D.C.), CHARLES K. HILL, ed., and OTHA H. VAUGHAN, ed. Feb. 1987 98 p Symposium held in Huntsville, Ala., 4 Dec. 1985
(NASA-CP-2429; M-547; NAS 1.55:2429) Avail: NTIS HC A05/MF A01 CSCL 22A

Papers and abstracts of the presentations made at the symposium are given as the scientific report for the Spacelab 3 mission. Spacelab 3, the second flight of the National Aeronautics and Space Administration's (NASA) orbital laboratory, signified a new era of research in space. The primary objective of the mission was to conduct applications, science, and technology experiments requiring the low-gravity environment of Earth orbit and stable vehicle attitude over an extended period (e.g., 6 days) with emphasis on materials processing. The mission was launched on April 29, 1985, aboard the Space Shuttle Challenger which landed a week later on May 6. The multidisciplinary payload included 15 investigations in five scientific fields: material science, fluid dynamics, life sciences, astrophysics, and atmospheric science.

N87-22390*# Management and Technical Services Co., Washington, D.C.
USSR SPACE LIFE SCIENCES DIGEST, ISSUE 11
LYDIA RAZRAN HOOKE, ed., VICTORIA GARSHNEK, ed., MIKE RADTKE, ed., RONALD TEETER, ed., and JOSEPH ROWE, ed. (Library of Congress, Washington, D. C.) Washington NASA May 1987 126 p
(Contract NASW-3676)
(NASA-CR-3922(13); NAS 1.26:3922(13)) Avail: NTIS HC A07/MF A01 CSCL 06B

This is the eleventh issue of NASA's USSR Space Life Sciences Digest. It contains abstracts of 54 papers recently published in Russian language periodicals and bound collections and of four new Soviet monographs. Selected abstracts are illustrated. Additional features include the translation of a paper presented in Russian to the United Nations, a review of a book on space ecology, and report of a conference on evaluating human functional capacities and predicting health. Current Soviet Life Sciences titles available in English are cited. The materials included in this issue have been identified as relevant to 30 areas of aerospace medicine and space biology. These areas are: adaptation, aviation physiology, biological rhythms, biospherics, body fluids, botany, cardiovascular and respiratory systems, cosmonaut training, developmental biology, endocrinology, enzymology, equipment and instrumentation, gastrointestinal systems, group dynamics, genetics, hematology, human performance, immunology, life support systems, mathematical modeling, metabolism, microbiology, musculoskeletal system, neurophysiology, nutrition, operational medicine, perception, personnel selection, psychology, and radiobiology. Author

N87-22548*# National Aeronautics and Space Administration, Washington, D.C.
RESEARCH AND TECHNOLOGY OBJECTIVES AND PLANS Summary Fiscal Year Report, 1985
Apr. 1985 187 p
(NASA-TM-87394; NAS 1.15:87394) Avail: NTIS HC A09/MF A01 CSCL 05A

This publication represents the NASA research and technology program for FY 1985. It is a compilation of the Summary portions of each of the RTOPs (Research and Technology Objectives and Plans) used for management review and control of research currently in progress throughout NASA. The RTOP summary is designed to facilitate communication and coordination among concerned technical personnel in government, in industry, and in universities. The first section containing citations and abstracts of the RTOPs is followed by four indexes: Subject, Technical Monitor, Responsible NASA Organization, and RTOP number. Author

N87-22602*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LANGLEY AEROSPACE TEST HIGHLIGHTS - 1986
May 1987 101 p
(NASA-TM-89144; NAS 1.15:89144) Avail: NTIS HC A06/MF A01 CSCL 05A

The role of the Langley Research Center is to perform basic and applied research necessary for the advancement of aeronautics and space flight, to generate new and advanced concepts for the accomplishment of related national goals, and to provide research advice, technological support, and assistance to other NASA installations, other government agencies, and industry. This report highlights some of the significant tests which were performed during calendar year 1986 in Langley test facilities, a number of which are unique in the world. The report illustrates both the broad range of the research and technology activities at the Langley Research Center and the contributions of this work toward maintaining United States leadership in aeronautics and space research. Author

N87-23027*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SP-100 ADVANCED TECHNOLOGY PROGRAM
RONALD J. SOVIE 1987 12 p Proposed for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA, ANS, ASME, SAE, IEEE, ACS and AIChE
(NASA-TM-89888; E-3576; NAS 1.15:89888; AIAA-87-9232)
Avail: NTIS HC A02/MF A01 CSCL 10B

The goal of the triagency SP-100 Program is to develop long-lived, compact, lightweight, survivable nuclear reactor space power systems for application to the power range 50 kWe to 1 MWe. The successful development of these systems should enable or significantly enhance many of the future NASA civil and commercial missions. The NASA SP-100 Advanced Technology Program strongly augments the parallel SP-100 Ground Engineering System Development program and enhances the chances for success of the overall SP-100 program. The purpose of this paper is to discuss the key technical elements of the Advanced Technology Program and the progress made in the initial year and a half of the project. Author

N87-23309# National Bureau of Standards, Gaithersburg, Md.
COOPERATIVE RESEARCH OPPORTUNITIES AT NBS (NATIONAL BUREAU OF STANDARDS)
Dec. 1986 57 p
(PB87-157236; NBS/SP-723; LC-86-600570) Avail: HC A04/MF A01; also available SOD HC $2.75 as 003-003-02788-0 CSCL 05A

A report on Cooperative Research Opportunities at the National Bureau of Standards (NBS) has the following contents: Cooperative Research At NBS; Research opportunities; Analytical chemistry; Applied mathematics; Basic standards; Building technology; Ceramics; Chemical engineering; Chemical physics; Computer sciences and technology; Electronics and electrical engineering;

Fire research; Fracture and deformation; Manufacturing engineering; Matallurgy; Neutron scattering and refraction; Nondestructive evaluation; Polymers; Product standards; Radiation research; Standards reference data. GRA

N87-24063*# National Aeronautics and Space Administration, Washington, D.C.
THE 1986-87 NASA SPACE/GRAVITATIONAL BIOLOGY ACCOMPLISHMENTS
THORA W. HALSTEAD, ed. Jun. 1987 223 p Prepared in cooperation with George Washington Univ., Washington, D.C.
(Contract NASW-3165)
(NASA-TM-89951; NAS 1.15:89951) Avail: NTIS HC A10/MF A01 CSCL 06B

This report consists of individual technical summaries of research projects of NASA's Space/Gravitational Biology program, for research conducted during the period January 1986 to April 1987. This program utilizes the unique characteristics of the space environment, particularly microgravity, as a tool to advance knowledge in the biological sciences; understanding how gravity has shaped and affected life on Earth; and understanding how the space environment affects both plant and animal species. The summaries for each project include a description of the research, a list of accomplishments, an explanation of the significance of the accomplishments, and a list of publications. Author

N87-24247*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ESSAYS IN SPACE SCIENCE
REUVEN RAMATY, ed., THOMAS L. CLINE, ed., and JONATHAN F. ORMES, ed. Jun. 1987 424 p Symposium held in Greenbelt, Md., 23 Apr. 1985
(NASA-CP-2464; REPT-87B0055; NAS 1.55:2464) Avail: NTIS HC A18/MF A01 CSCL 03B

The papers presented cover a broad segment of space research and are an acknowledgement of the personal involvement of Frank McDonald in many of these efforts. The totality of the papers were chosen so as to sample the scientific areas influenced by him in a significant manner. Three broad areas are covered: particles and fields of the solar system; cosmic ray astrophysics; and gamma ray, X-ray, and infrared astronomics.

N87-24390*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ENGINEER IN CHARGE: A HISTORY OF THE LANGLEY AERONAUTICAL LABORATORY, 1917-1958
JAMES R. HANSEN (Maine Univ., Orono.) Washington, D.C. 1986 643 p NASA History Series
(Contract NASW-3502)
(NASA-SP-4305; NAS 1.21:4305) Avail: SOD HC $30.00 as 033-000-00999-2; NTIS MF A01 CSCL 05B

A history is presented by using the most technologically significant research programs associated with the Langley Aeronautical Laboratory from 1917 to 1958 and those programs that, after preliminary research, seemed best to illustrate how the laboratory was organized, how it works, and how it cooperated with industry and the military. B.G.

N87-24391*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
RESEARCH AND TECHNOLOGY Annual Report, 1986
Apr. 1987 184 p
(NASA-TM-89411; A-87031; NAS 1.15:89411) Avail: NTIS HC A09/MF A01 CSCL 05D

Selected achievements at the Ames-Moffett and Ames-Dryden sites of the Ames Research Center are illustrated. The challenging work that was accomplished in the past year is presented for the following areas: engineering and technical services, aerospace systems, flight operations and research, aerophysics, and space research. B.G.

N87-24392*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
RESEARCH AND TECHNOLOGY Annual Report, 1986
Dec. 1986 66 p
(NASA-TM-89193; NAS 1.15:89193) Avail: NTIS HC A04/MF A01 CSCL 05D

As the NASA Center responsible for assembly, checkout, servicing, launch, recovery, and operational support of Space Transportation System elements and payloads, Kennedy Space Center is placing increasing emphasis on the Center's research and technology program. In addition to strengthening those areas of engineering and operations technology that contribute to safer, more efficient, and more economical execution of our current mission, we are developing the technological tools needed to execute the Center's mission relative to future programs. The Engineering Development Directorate encompasses most of the laboratories and other Center resources that are key elements of research and technology program implementation, and is responsible for implementation of the majority of the projects in this Kennedy Space Center 1986 Annual Report. Author

N87-24739*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
EARTH SURFACE SENSING IN THE '90'S
CHARLES ELACHI *In* ESA Proceedings of the International Symposium on Progress in Imaging Sensors p 1-11 Nov. 1986 Original document contains color illustrations Sponsored by NASA
Avail: NTIS HC A99/MF A01 CSCL 08B

Advances in Earth sensor technology and data handling techniques are reviewed. These will allow the acquisition of high resolution images over a wide range of the electromagnetic spectrum (from microwave to optical) with sufficient spectral resolution to permit detailed analysis of the surface chemical, thermal, and physical properties. When combined with the topography, this will allow the user to analyze the full data set in a perspective view that enhances interpretation capability. ESA

N87-25029# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space Science Dept.
MAIN ACHIEVEMENTS AND FUTURE PLANS IN ESA'S PROGRAM
ARNE PEDERSEN *In its* Proceedings of the GIREP Conference 1986. Cosmos: An Educational Challenge p 21-24 Nov. 1986
Avail: NTIS HC A20/MF A01

The achievements of the ESA space science program in traditional space science disciplines such as space plasma physics, astronomy, and planetary research are outlined. The future science programs, and the science elements in the Earth observation, meteorology, and microgravity programs are described. ESA

N87-25030# National Aeronautics and Space Administration, Washington, D.C.
EXPLORATION OF THE SOLAR SYSTEM: ACHIEVEMENTS AND FUTURE PLANS IN NASA'S PROGRAMME
WILLIAM E. BRUNK *In* ESA Proceedings of the GIREP Conference 1986. Cosmos: An Educational Challenge p 25-29 Nov. 1986
Avail: NTIS HC A20/MF A01

The Voyager 2 encounter with Uranus, ground-based and spacecraft observations of Comet Halley, and other NASA solar system exploration is reviewed. The Challenger tragedy significantly delayed the next NASA planetary mission, Galileo, as well as the Ulysses and the Space Telescope missions, all of which will provide data vital to understanding of the solar system. However, the results anticipated from these missions, as well as those from the 1989 Voyager encounter with Neptune and from other approved and planned planetary missions promise that NASA's future role in solar system exploration will remain alive and vital. ESA

N87-25031# Consiglio Nazionale delle Ricerche, Rome (Italy). Piano Spaziale Nazionale.
THE COLUMBUS PROGRAM
ALBERTO LORIA *In* ESA Proceedings of the GIREP Conference 1986. Cosmos: An Educational Challenge p 31-36 Nov. 1986
Avail: NTIS HC A20/MF A01

The Columbus permanently manned space station project is outlined. In its first stage Columbus will have tight links with the International Space Station, the assembly of which is planned to start in 1993. Columbus should then develop into an autonomous European space station. The flight elements under negotiation with NASA with necessary ground infrastructures are described. Plans for the utilization of the system are summarized. ESA

N87-25255*# National Aeronautics and Space Administration, Washington, D.C.
ADVANCES IN PLANETARY GEOLOGY
JOHN A. GRANT, III and SUSAN S. NEDELL Jun. 1987 437 p
(NASA-TM-89871; NAS 1.15:89871) Avail: NTIS HC A19/MF A01 CSCL 03B

The surface of Mars displays a broad range of channel and valley features. There is as great a range in morphology as in scale. Some of the features of Martian geography are examined. Geomorphic mapping, crater counts on selected surfaces, and a detailed study of drainage basins are used to trace the geologic evolution of the Margaritifer Sinus Quandrangle. The layered deposits in the Valles Marineris are described in detail and the geologic processes that could have led to their formation are analyzed.

N87-25879# Lister Hill National Center for Biomedical Communications, Bethesda, Md.
RESEARCH LIBRARY TRENDS, 1951-1980 AND BEYOND: AN UPDATE OF PURDUE'S PAST AND LIKELY FUTURE OF 58 RESEARCH LIBRARIES Final Technical Report
WARREN F. SEIBERT, MARJORIE A. KUENZ, PAUL A. GAMES (Pennsylvania State Univ., University Park.), and RICHARD W. GREGG Mar. 1987 196 p
(PB87-174280; LHNCBC-87-2) Avail: NTIS HC A09/MF A01 CSCL 05B

The research extends the Purdue studies of research library growth, presenting results that include library statistical trends during a 35 year period, 1951 to 1985. This study serves to update Purdue's nine-report series (1965 through 1973) and is a validation study of Purdue's growth forecasts, 28 of which were published in 1965, then revised in 1971. The research libraries considered here represent 58 first tier American reseach universities that were members of the Association of Reseach Libraries (ARL) in 1964, when the Purdue studies began; all are still members. The results describe 35 years of growth and change in library holdings, volumes added, professional and nonprofessional staff size, and in three expenditure categories (salaries, materials and binding, and total), and total, plus university/main campus total and graduate enrollments, and Ph.D. degrees awarded. Growth trends are reported for eight composite libraries that differ in size, i.e., the average or mean; the median, first quartile and third quartile; and four collection (or holdings) subgroups: the large, medium-large, medium-small, and small. Correlation findings also show the strength of relationship, year-by-year, among the study variables. Some estimates of future growth through 1990 are presented together with suggestions for further research. GRA

N87-26073* National Aeronautics and Space Administration, Washington, D.C.
SPACE STATION SYSTEMS: A BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 4)
May 1987 220 p
(NASA-SP-7056(04); NAS 1.21:7056(04)) Avail: NTIS HC A10 CSCL 22B

This bibliography lists 832 reports, articles, and other documents introduced into the NASA scientific and technical information system between July 1, 1986 and December 31, 1986. Its purpose is to provide helpful information to the researcher, manager, and designer in technology development and mission design according to system, interactive analysis and design, structural and thermal analysis and design, structural concepts and control systems, electronics, advanced materials, assembly concepts, propulsion, and solar power satellite systems. The coverage includes documents that define major systems and subsystems, servicing and support requirements, procedures and operations, and missions for the current and future space station. Author

N87-26448*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACECRAFT 2000: THE CHALLENGE OF THE FUTURE
HENRY W. BRANDHORST, JR., KARL A. FAYMON, and ROBERT W. BERCAW *In its* Space Photovoltaic Research and Technology 1986. High Efficiency, Space Environment and Array Technology p 333-341 Jun. 1987
Avail: NTIS HC A16/MF A01 CSCL 10B

Considerable opportunity exists to improve the systems, subsystems, components, etc., included in the space station bus, the non-payload portion of the spacecraft. The steps followed to date, the challenges being faced by industry, and the progress toward establishing a new NASA initiative which will identify the technologies required to build spacecraft of the 21st century and which will implement the technology development/validation programs necessary are described. Author

N87-26496*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
RESULTS OF THE LIFE SCIENCES DSOS CONDUCTED ABOARD THE SPACE SHUTTLE 1981-1986
MICHAEL W. BUNGO, TANDI M. BAGIAN, MARK A. BOWMAN, and BARRY M. LEVITAN (Krug International, Houston, Tex.) May 1987 191 p
(NASA-TM-58280; S-561; NAS 1.15:58280) Avail: NTIS HC A09/MF A01 CSCL 06C

Results are presented for a number of life sciences investigations sponsored by the Space Biomedical Research Institute at the NASA Lyndon B. Johnson Space Center and conducted as Detailed Supplementary Objectives (DSOs) on Space Shuttle flights between 1981 and 1986. An introduction and a description of the DSO program are followed by summary reports on the investigations. Reports are grouped into the following disciplines: Biochemistry and Pharmacology, Cardiovascular Effects and Fluid Shifts, Equipment Testing and Experiment Verification, Microbiology, Space Motion Sickness, and Vision. In the appendix, the status of every medical/life science DSO is presented in graphical form, which enables the flight history, the number of subjects tested, and the experiment results to be reviewed at a glance. Author

N87-26930*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
CHRONOLOGY OF KSC AND KSC-RELATED EVENTS FOR 1985
KEN NAIL, JR. and ELAINE LISTON (New World Services, Inc., Fla.) Mar. 1986 121 p
(NASA-TM-89364; KSC-KHR-10; NAS 1.15:89364) Avail: NTIS HC A06/MF A01 CSCL 22A

A chronology of developments and events at the Kennedy Space Center (KSC) in 1985 documents the KSC role in NASA's progress. The chronology serves as a reference source for historians and other researchers. Arrangement is by day and month. Individual articles are attributed to published sources. Author

N87-27475*# The Futures Group, Glastonbury, Conn.
NASA LEWIS RESEARCH CENTER FUTURING WORKSHOP Final Report
MARK BOROUSH, JOHN STOVER, and CHARLES THOMAS Jan. 1987 156 p Workshop held in Cleveland, Ohio, 21-22 Oct. 1986
(Contract NASA ORDER C-21030)
(NASA-CR-179577; NAS 1.26:179577) Avail: NTIS HC A08/MF A01 CSCL 12B

On October 21 and 22, 1986, the Futures Group ran a two-day Futuring Workshop on the premises of NASA Lewis Research Center. The workshop had four main goals: to acquaint participants with the general history of technology forecasting; to familiarize participants with the range of forecasting methodologies; to acquaint participants with the range of applicability, strengths, and limitations of each method; and to offer participants some hands-on experience by working through both judgmental and quantitative case studies. Among the topics addressed during this workshop were: information sources; judgmental techniques; quantitative techniques; merger of judgment with quantitative measurement; data collection methods; and dealing with uncertainty. Author

N87-27560*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SCIENTIFIC AND TECHNICAL PAPERS PRESENTED OR PUBLISHED BY JSC AUTHORS IN 1986
Jul. 1987 156 p
(NASA-TM-100457; S-563; NAS 1.15:100457) Avail: NTIS HC A08/MF A01 CSCL 05B

A compilation of Lyndon B. Johnson Space Center contributions to the scientific and technical literature in aerospace and life sciences made during calender year 1985 is presented. Citations include NASA formal series reports, journal articles, conference and symposium presentations, papers published in proceedings or other collective works, and seminar and workshop results. Author

N87-27593*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ACTIVITIES OF THE JET PROPULSION LABORATORY Annual Report, 1985
Apr. 1986 63 p
(NASA-CR-181199; NAS 1.26:181199; JPL-400-284) Avail: NTIS HC A04/MF A01 CSCL 05D

Work accomplished by the Jet Propulsion Laboratory (JPL) under contract to NASA in 1985 is described. The work took place in the areas of flight projects, space science, geodynamics, materials science, advanced technology, defense and civil programs, telecommunications systems, and institutional activities. J.P.B.

N87-27609*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SOME INNOVATIONS AND ACCOMPLISHMENTS OF AMES RESEARCH CENTER SINCE ITS INCEPTION
May 1987 38 p Original contains color illustrations
(NASA-TM-88348; A-86375; NAS 1.15:88348) Avail: NTIS HC A03/MF A01 CSCL 01B

The innovations and accomplishments of Ames Research Center from 1940 through 1966 are summarized and illustrated. It should be noted that a number of accomplishments were begun at the NASA Dryden Flight Research Facility before that facility became part of the Ames Research Center. Such accomplishments include the first supersonic flight, the first hypersonic flight, the lunar landing research vehicle, and the first digital fly-by-wire aircraft. Author

N87-28455*# National Aeronautics and Space Administration, Washington, D.C.
NASA EDUCATIONAL PUBLICATIONS
1987 24 p
(PAM-101/7-87; SB-222) Avail: SOD HC free as 021-222-00702-4 (Subject Bibliography 222) CSCL 05B

This is a catalog of educational and technical publications, sponsored by NASA, that are available to the general public from the Government Printing Office (GPO). The following types of publications are announced: periodicals, educational publications, NASA Facts, posters and wallsheets, other publications of interest to educators, scientific and technical publications, and educational materials from Regional Service Centers. J.P.B.

N87-29024# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
SPACE 2000 IN EUROPE
K. REINHARTZ and H. STOEWER *In its* Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 451-459 Nov. 1986
Avail: NTIS HC A21/MF A01

European space programs including the Columbus space station, Ariane 5, Hermes, Cluster, XMM, Comet Nucleus Sample Return Mission, Infrared Heterodyne Spectroscopy Mission, the microgravity program, the communications program, data relay systems, navigation systems, and space commercialization are summarized. ESA

N87-29403*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
RESEARCH AND TECHNOLOGY: 1986 ANNUAL REPORT OF THE LYNDON B. JOHNSON SPACE CENTER Annual Report
Dec. 1986 73 p
(NASA-TM-58277; S-557; NAS 1.15:58277) Avail: NTIS HC A04/MF A01 CSCL 05B

Johnson Space Center accomplishments in new and advanced concepts during 1986 are highlighted. Included are research funded by the Office of Aeronautics and Space Technology; Solar System Exploration and Life Sciences research funded by the Office of Space Sciences and Applications; and Advanced Programs tasks funded by the Office of Space Flight. Summary sections describing the role of the Johnson Space Center in each program are followed by one-page descriptions of significant projects. Descriptions are suitable for external consumption, free of technical jargon, and illustrated to increase ease of comprehension. Author

N87-29577*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AEROTHERMODYNAMICS RESEARCH AT NASA AMES RESEARCH CENTER
GEORGE S. DEIWERT Sep. 1987 39 p Submitted for publication
(NASA-TM-89439; A-87149; NAS 1.15:89439) Avail: NTIS HC A03/MF A01 CSCL 22A

Research activity in the aerothermodynamics branch at the NASA Ames Research Center is reviewed. Advanced concepts and mission studies relating to the next generation aerospace transportation systems are summarized and directions for continued research identified. Theoretical and computational studies directed at determining flow fields and radiative and convective heating loads in real gases are described. Included are Navier-Stokes codes for equilibrium and thermochemical nonequilibrium air. Experimental studies in the 3.5-ft hypersonic wind tunnel, the ballistic ranges, and the electric arc driven shock tube are described. Tested configurations include generic hypersonic aerospace plane configurations, aeroassisted orbital transfer vehicle shapes and Galileo probe models. Author

N87-29612*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE ACEE PROGRAM AND BASIC COMPOSITES RESEARCH AT LANGLEY RESEARCH CENTER (1975 TO 1986): SUMMARY AND BIBLIOGRAPHY
MARVIN B. DOW Oct. 1987 147 p
(NASA-RP-1177; L-16290; NAS 1.61:1177) Avail: NTIS HC A07/MF A01 CSCL 11D

Composites research conducted at the Langley Research Center during the period from 1975 to 1986 is described, and an annotated bibliography of over 600 documents (with their abstracts) is presented. The research includes Langley basic technology and the composite primary structures element of the NASA Aircraft Energy Efficiency (ACEE) Program. The basic technology documents cited in the bibliography are grouped according to the research activity such as design and analysis, fatigue and fracture, and damage tolerance. The ACEE documents cover development of composite structures for transport aircraft. Author

N87-29849# Brookhaven National Lab., Upton, N. Y.
RESEARCH QUALITY: THE R AND D COMMUNITY RESPONDS QUALITY ASSURANCE FROM A RESEARCHER'S PERSPECTIVE
R. THOMAS 1987 7 p Presented at the 14th Annual National American Society for Quality Control, Las Vegas, Nev., 14 Sep. 1987
(Contract DE-AC02-76CH-00016)
(DE87-012478; BNL-39992; CONF-870950-2) Avail: NTIS HC A02/MF A01

Real basic scientific research principally is individual human expression, with no known proven techniques or procedures to achieve its purpose. For this reason present day quality assurance techniques are only applicable to the myriad of measurements, procedures, constructions, etc., which are carried out in support of basic scientific research, but which are themselves not basic scientific research. DOE

N87-29903*# National Aeronautics and Space Administration, Washington, D.C.
NASA FACTS: HOW WE GET PICTURES FROM SPACE
ROBERT HAYNES 1987 12 p Original document contains color illustrations
(NASA-NF-151/8-86; NAS 1.20:151/8-86) Avail: NTIS HC A02/MF A01 CSCL 22A

The past 25 years of space travel and exploration has generated an unprecedented quantity of data from planetary systems. Images taken in space and telemetered back to Earth have greatly aided scientists in formulating better and more accurate theories about the nature and origin of out solar system. The procedures and spacecraft systems used to gather data are explained. B.G.

07

ECONOMICS, COSTS AND MARKETS

Includes Costs and Cost Analysis, Cost Control and Cost Effectiveness, Productivity and Efficiency, Economics and Trade, Financial Management and Finance, Investments, Value and Risk (Monetary), Budgets and Budgeting, Marketing and Market Research, Consumerism, Purchasing, Sales, Commercialization, Competition, Accounting.

A87-10033* National Aeronautics and Space Administration, Washington, D.C.
GET AWAY SPECIAL THE LOW-COST ROUTE TO ORBIT
C. PROUTY (NASA, Customer Services Div., Washington, DC) IN: Space Congress, 23rd, Cocoa Beach, FL, April 22-25, 1986, Proceedings . Cape Canaveral, FL, Canaveral Council of Technical Societies, 1986, p. 3-17 to 3-44.

NASA has established the Get Away Special (GAS) program as a means for providing anyone who wishes the opportunity to place a small self-contained experimental payload aboard a Space Shuttle mission for a very low cost. The GAS program is now well established, and has a respectable history with 53 payloads flown to date. The GAS experimenters are a diverse group who have demonstrated that people from all walks of life, and from many nations, are interested in working in space. This paper traces the history of the program from its concept through the development phase to the present time, and takes a brief look at the future. It also addresses the steps involved in making a payload reservation and the programmatic and technical relationships that are established between NASA and GAS customers. Author

A87-10045
CUSTOMER UTILIZATION REQUIREMENTS AND THEIR IMPACT FOR SPACE STATION CAPABILITIES
M. E. VAUCHER (Center for Space Policy, Inc., Cambridge, MA) IN: Space Congress, 23rd, Cocoa Beach, FL, April 22-25, 1986, Proceedings . Cape Canaveral, FL, Canaveral Council of Technical Societies, 1986, p. 7-12 to 7-74.

The effect of customer requirements on the design of Space Station capabilities is evaluated. Market and environment analyses were utilized to determine the potential Space Station users and their requirements. The Station users are identified as commercial, NASA, academic and scientific, international, and NOAA and they are grouped functionally. In order to determine users needs, the functional capabilities of the Station's systems are related to the users requirements. Attribute matrix scores were applied to the core capabilities and user specific attributes of the Station, and four functional grouping were identified: (1) manned microgravity, (2) research on-orbit service and assembly, (3) on-orbit observations/remote sensing, and (4) commercial materials manufacturing. It is noted that the three main design goals for the Station are: (1) design to cost, (2) design for growth, and (3) user friendly. I.F.

A87-10506
SPACE COMMERCIALIZATION AND THE FEDERAL INCOME TAX
J. V. BAIRD (Andrews and Kurth, Houston, TX) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 51, Summer 1986, p. 897-926. refs

The present article addresses the impact of the Internal Revenue Code of 1954, as amended (the 'Code'), on the structure and conduct of space business activities operated by U.S. taxpayers. The considered issues are illustrated with the aid of an example, which is partly based on an actual proposed commercial venture. The example involves the development of a conceptual design for an industrial space facility (the 'ISF') by a company. Attention is given to considerations regarding the formation of the company, a bias in the Code against new entities, problems related to the raising of new capital, the tax treatment of costs of

constructing ISF, tax treatment of operating ISF, special problems of leasing ISF to government, tax treatment of payments to transportation, and tax treatment of processing. It is pointed out that members of Congress have proposed legislation which would eliminate some of the discussed discrimination of the Code against space-oriented activities. G.R.

A87-10507
EXPORT CONTROLS AFFECTING SPACE OPERATIONS
A. M. DULA (Dula, Shields and Egbert, Houston, TX) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 51, Summer 1986, p. 927-950. refs

It is pointed out that the sale of aircraft is a major source of positive trade payments for the U.S. While the market for space goods and services could quickly exceed the aeronautical market, there exist currently a number of difficulties regarding such developments. Thus, goods manufactured, property owned, and activities conducted in space are currently considered to be outside the U.S. for tax, patent, customs, and export purposes. Attention is given to outer space activity subjected to export controls, commercial space activity, military space activity, and the three mechanisms controlling exports from the U.S. A solution to the considered dilemma is also proposed. All activities occurring within the jurisdiction of the U.S. in space on facilities launched by U.S. registry space vehicles should be considered to be within the U.S. for legal purposes. The best change for true security is thought to lie in a rapid exchange of ideas and products between the free nations of the West. G.R.

A87-13102
GROWTH OF THE ADVANCED COMPOSITES INDUSTRY IN THE 1980'S
J. K. KUNO (Northrop Corp., Advanced Systems Div., Pico Rivera, CA) IN: International SAMPE Symposium and Exhibition, 31st, Los Angeles, CA, April 7-10, 1986, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1986, p. 725-737.

The growth of Kevlar, fiberglass and graphite fiber-based composites is traced from early 1972 to 1986. Sales for these three materials have grown from $46 million in 1973 to $294 million in 1985. Sales and products manufactured by the eight major U.S. graphite fiber manufacturers have grown from 111,000 to 3 million pounds, and from $96 million for 1985. Market trends for 1985 for the graphite prepreg manufacturer show that their sales have grown from $12 million in 1973, to a projected growth of $165 million for 1985. Author

A87-13140
MATERIAL AND PROCESS OPPORTUNITIES IN SPACE
C. R. DAVIES (Ethertec Space Technology, Mims, FL) IN: International SAMPE Symposium and Exhibition, 31st, Los Angeles, CA, April 7-10, 1986, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1986, p. 1214-1225. refs

The use of space as a manufacturing environment is discussed. The significance of the microgravity, radiation, and vacuum existing in space for manufacturing is reviewed, and the potential of space-based manufacturing for improving the current state of technologies in the areas of crystal growth, containerless processing, separation, and high-efficiency chemical reactions is addressed. Methods of conducting experiments relevant for space-based manufacturing are discussed, including earth-based simulation of the space environment, low-cost space-based experimentation, and moderate scale space-based experimentation. Short term possibilities and long term goals and visions for space-based materials manufacturing and processing are examined. C.D.

A87-13470
THE SPACE INDUSTRY: TRADE RELATED ISSUES
Paris, Organisation for Economic Co-operation and Development, 1985, 94 p. refs

Space activities including the development of space products, hardware, and services are discussed. The present and future space markets are examined with particular attention to telecommunications, weather forecasting, and remote satellites, and earth stations. The ground segment, launching, and space segment costs for satellite are evaluated. Corporate strategies for the commercialization of space are described. The role of the government in the commercialization of space, and the relation between space production and public budgets are considered. I.F.

A87-14597
A RISK COST ANALYSIS PROCEDURE AS APPLIED TO ADVANCED SPACE PROGRAMS
A. FORSTER (Aerospace Corp., Resource Cost Analysis Office, El Segundo, CA) IN: International Society of Parametric Analysts, Annual Conference, 7th, Orlando, FL, May 7-9, 1985, Proceedings. Volume 4, Number 1 . McLean, VA, International Society of Parametric Analysts, 1986, p. 249-276.

A cost risk analysis procedure is described for forecasting costs of advanced space concepts years or decades in the future. The final work product developed for the program office, identifying the cost risk or uncertainties, takes the form of a cost risk range map. The range map shows the probabilities of occurrence for a satellite system (based on classified work but with fictitious numbers) whose cost and weight estimates have been calculated. Two types of uncertainty are dealt with: that due to the regression equation (objective risk) and that due to the technology data base (subjective risk). A customized software program, using Lotus 123 and running on an IBM compatible microcomputer, has been developed to provide a Monte Carlo simulation risk cost model. D.H.

A87-16022#
TELESAT CANADA'S ANIK E SPACECRAFT
E. BERTENYI and R. TINLEY (Telesat Canada, Ottawa) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 12 p. refs
(IAF PAPER 86-327)

Starting in 1990, Telesat Canada will need to replenish its C-band and Ku-band space segments because of service life considerations. The need to replace both C-band and Ku-band satellites within a short timeframe, and the availability of new large capacity spacecraft service modules has enabled Telesat to specify dual band satellites for its fifth generation Anik E space segment. Two Anik E satellites will be launched in 1990 and will provide enhanced performance in both frequency bands, compared to the existing space segment. The satellites promise significant cost savings over single-band satellites of comparable performance. This paper reviews the main performance requirements and the key spacecraft design features of Anik E. The dual band communications subsystem is discussed in some datail, and the main features of the service module are also addressed. Author

A87-17022
COST EFFECTIVE TRANSPORTATION AND HIGH TECHNOLOGY
J. M. SWIHART (Boeing Commercial Airplane Co., Seattle, WA) Aeronautical Journal (ISSN 0001-9240), vol. 90, Aug.-Sept. 1986, p. 249-261.

A comprehensive evaluation is made of the benefits of the intensive application of novel aerodynamic, structural and propulsion technologies to commercial aircraft. These technologies, which encompass boundary layer laminarization, aluminum-lithium alloys, filament-wound composite shells, composite primary structures, thermoplastic resins, advanced digital avionics, and single and contrarotating rotor propfan engines, are aimed at reducing manufacturing and operating costs and improving such aspects of performance as fuel consumption and range. The most

likely future configurations for subsonic and supersonic airliners are noted. O.C.

A87-17996* National Aeronautics and Space Administration, Washington, D.C.
THE INTERNATIONAL AEROSPACE INDUSTRY - NEW CHALLENGES AND OPPORTUNITIES FOR TRANSLATION SUPPLIERS
T. ROWE (NASA, Washington, DC) IN: American Translators Association, Annual Conference, 27th, Cleveland, OH, October 16-19, 1986, Proceedings. Medford, NJ, Learned Information, Inc., 1986, p. 105-109. refs

Attention is given to the recent trend toward internationalization in the aerospace industry and its effects on commercial and governmental translation programs. The aerospace industry, once dominated by organizations from a small number of countries, is now widely international in scope. In effect, there has been in increase in the demand for translations from German, Japanese, Chinese, French and Spanish source material while that for translation from Russian source material has remained constant. The impact of the Challenger disaster on aerospace translation programs is discussed as well as the impact of international participation in Space Station research. K.K.

A87-18207
SPACE DEVELOPMENT ACTIVITIES IN JAPAN
M. YAMANOUCHI and Y. TAKENAKA (National Space Development Agency of Japan, Tokyo) IN: International Symposium on Space Technology and Science, 14th, Tokyo, Japan, May 27-June 1, 1984, Proceedings . Tokyo, AGNE Publishing, Inc., 1984, p. 53-73. refs

There are two categories of space activities in Japan: scientific exploration and practical applications. By February 1984, a total of 29 satellites have been launched. These activities are mainly carried out by ISAS and NASDA, in cooperation with many organizations and under the Outlines of Japan's Space Development Policy issued by the Space Activities Commission which is an advisory organ of the Prime Minister. This paper describes the Outlines and provides an overview of Japan's space activities, including recent developments of launch vehicles and satellites as well as future plans. Author

A87-18478
THE INTERESTS OF JAPANESE INDUSTRY FOR COMMERCIALIZATION OF SPACE
S. OOBAYASHI (Ishikawajima-Harima Heavy Industries, Ltd., Tokyo, Japan) IN: Space exploitation and utilization; Proceedings of the Symposium, Honolulu, HI, December 15-19, 1985 . San Diego, CA, Univelt, Inc., 1986, p. 429-439.
(AAS PAPER 85-650)

Enterprises in Japan, relating to electronics or biomaterials, will begin to conduct space experiments in material processing in the coming years. However, Japan, not having its own spaceflight capability until the Space Station becomes available, will want to participate in other countries' space flights. As the trend for the utilization of space becomes more apparent, the Japanese government will take measures such as establishing a promotion organization and an incentive system. Japanese enterprises plan to conduct, in the 1990s, fundamental experiments on the JEM (Japan Experiment Module) of the Space Station, as well as experiments for practical use and production on the free flyer. D.H.

A87-22050
ARE THE SOVIETS AHEAD IN SPACE?
THOMAS Y. CANBY National Geographic (ISSN 0027-9358), vol. 170, Oct. 1986, p. 420-459.

The developmental history of the Soviet space program is traced and future plans are discussed. Emphasis is placed on developments regarding Space Stations, Shuttle-type vehicles, space industries, and missions to the moon and Mars. Consideration is also given to the military implications of the Soviet space program. The salvaging of the crippled Salyut 7 Space Station is described in detail. It is argued that the Soviet space budget approximates that of the U.S. (the equivalent of about 22 billion dollars for 1985) but probably doubles the U.S. commitment in terms of gross national product. K.K.

A87-24710#
A EUROPEAN VIEWPOINT OF THE DEVELOPMENT OF THE COMMUNICATION SATELLITE MARKET
YVES DEMERLIAC (European Industrial Group for Space Studies, Paris, France) IN: Digital networks and their evolution - Space and terrestrial systems; Proceedings of the Thirty-third International Congress on Electronics and Twenty-sixth International Meeting on Space, Rome, Italy, Mar. 18-20, 1986 . Rome, Rassegna Internazionale dell'Elettronica, dell'Energia, e dello Spazio, 1986, p. 361-365.

This paper will concentrate on the European share in the space sector of the communication satellite market worldwide. Both telecommunications proper and TV will be considered. The expected declining trend of this market will be analyzed to show the reasons for the current pessimism in the European industry concerned. Finally, the conditions for the improvement of the situation will be reviewed and it is hoped that this paper will leave you with the more pleasant impression that sufficient communication requirements and resources exist in Europe to keep the industry active provided that certain administrative and organizational steps are taken by the governments. Author

A87-24712#
SATELLITE COMMUNICATIONS NETWORKS FOR THE 21ST CENTURY
DAVID GREGORY (British Aerospace, PLC, Weybridge, England) IN: Digital networks and their evolution - Space and terrestrial systems; Proceedings of the Thirty-third International Congress on Electronics and Twenty-sixth International Meeting on Space, Rome, Italy, Mar. 18-20, 1986 . Rome, Rassegna Internazionale dell'Elettronica, dell'Energia, e dello Spazio, 1986, p. 407-415.

Todays Communications and Broadcasting satellites may be broadly divided into international and Regional/national categories, with the international satellite systems providing transoceanic communications by stationing satellites in the middle of the oceans. The advent of intersatellite links will permit new global configurations of satellites, with clusters of spacecraft providing regional services, connected to adjacent clusters by means of intersatellite links. Satellites forming such clusters are envisaged as being of a new pattern, three-axis stabilized but sun pointing. The paper describes design features and advantages of such spacecraft and the way in which they would be used to create the telecommunications infrastructure of the 21st Century. Author

A87-25440
ENTREPRENEURS IN SPACE
JUNIUS ELLIS Air and Space (ISSN 0886-2257), vol. 1, Dec. 1986-Jan. 1987, p. 98-101.

Business aspects of the development of the Transfer Orbit Stage (TOS), the booster selected for the NASA Mars Observer probe (scheduled launch 1990) are discussed. The problems facing small new aerospace enterprises in obtaining financing and competing successfully for contracts are described, using details of the TOS history as examples. Also considered are efforts by the developers to adapt the TOS to a number of future Shuttle-launched missions. T.K.

A87-25444
ECONOMIC JUSTIFICATION FOR SPACE-BASED PHARMACEUTICAL DEVELOPMENT AND PRODUCTION
J. LYLE BOOTMAN, WILLIAM F. MCGHAN, STEPHEN JOEL COONS (Arizona, University, Tucson), and MILAN BIER International Space Business Review, vol. 1, July-Aug. 1986, p. 40-45. refs

Cost-benefit analysis (CBA) and cost-effectiveness analysis of space-based pharmaceutical production is discussed. The five basic steps of such a CBA are described, including problem

determination, identification of alternative mechanism and valued outcome, benefit determination, determination of resources and costs, and sensitivity analysis. Potential pharmaceutical products for space-based research, development, and production are listed, and the potential for space-based production of thrombolytic agents is discussed. C.D.

A87-25448
EURECA - A RETRIEVABLE FREE-FLYER FOR COMMERCIAL APPLICATIONS
D. J. SHAPLAND and R. MORY (ESA, Directorate of Space Station and Platforms, Paris, France) International Space Business Review, vol. 1, July-Aug. 1986, p. 62-66.

The European Retrievable Carrier (Eureca), which bridges the gap between the present time and the arrival of the Space Station, is discussed. The cost and commercial applications of the Eureca and its operational concept are reviewed, and its design is described. The first Eureca flight, scheduled to take place in early 1988 with retrieval six months later, is briefly described, and Eureca's microgravity applications and mission potential are summarized. Some cost considerations are addressed, and the relation of Eureca to the Space Station is discussed. C.D.

A87-25451
SPACE STATION: GATEWAY TO SPACE MANUFACTURING; PROCEEDINGS OF THE CONFERENCE, ORLANDO, FL, NOV. 7, 8, 1985
Conference sponsored by Pasha Publications. Arlington, VA, Pasha Publications, 1985, 437 p. For individual items see A87-25452 to A87-25461.

Opportunities for commercial manufacturing operations on the Space Station are discussed in reviews and reports by NASA and industry experts. Topics examined include private initiatives and opportunities, promising new technologies, low-cost starting options, new types of space-operations financing, and initial space laboratories and factories. Extensive diagrams, tables, and drawings are provided. T.K.

A87-25886
U.S. MANUFACTURERS BEGIN THE JOB OF REBUILDING THE U.S. SPACE PROGRAM - ELVS
THERESA FOLEY Commercial Space (ISSN 8756-4831), vol. 2, Fall 1986, p. 16-21.

The current status and future prospects of ELVs in the U.S. are discussed. The launching services provided by various private U.S. companies are described. Consideration is given to the launch costs, launch capabilities, scheduling, and reliability of the Titan, Atlas/Centaur, Delta, Jarvis, Conestoga, and Industrial Launch Vehicle ELVs. The competition for launch services between U.S. and foreign ELVs is examined. I.F.

A87-25887
THE NEXT 50 YEARS WILL BRING ABOUT MASSIVE CHANGES IN USES OF SPACE
LEONARD DAVID (Space Data Resources and Information, Washington, DC) Commercial Space (ISSN 8756-4831), vol. 2, Fall 1986, p. 36-39.

The commercialization of space is discussed. Particular attention is given to the establishment of bases on Mars and the moon. Research programs which require further study in order to commercialize space are examined. Consideration is given to the need to reduce transportation costs and utilize space resources. I.F.

A87-25888
THE SPACE SHUTTLE ACCIDENT FORCES COMPANIES TO CHANGE PLANS
MARC E. VAUCHER and KELLY ROBERTSON (Center for Space Policy, Inc., Cambridge, MA) Commercial Space (ISSN 8756-4831), vol. 2, Fall 1986, p. 42-49.

The activities of private U.S. companies in space commercialization as of September 1986 are described. Consideration is given to satellite communications, materials processing in space, remote sensing, space transportation, in-orbit services, and ground-based services. I.F.

A87-25889
CHALLENGE FROM EUROPE
Commercial Space (ISSN 8756-4831), vol. 2, Fall 1986, p. 58-60.

The European approach to developing a commercial space industry by establishing a market in a variety of space-based services is examined. The joint U.S./French project concerned with developing a system of mobile location and message transmission services covering Europe, Africa, and the Middle East, Locstar, and an American-based system, Geostar, is described. The marketing of the Argos satellite location and data collection services and efforts to promote space activities in the microgravity environment of low earth orbit are discussed. I.F.

A87-25983
FINANCIAL IMPLICATIONS AFFECTING THE SYSTEMS ASPECT OF AEROSPACE PROJECTS
LEO A. MALLETTE and KATHRYN J. MALLETTE (Mallette Investment Group, San Dimas, CA) IN: Aerospace Applications Conference, Steamboat Springs, CO, Feb. 1-8, 1986, Digest . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, 9 p. refs

Attention is given to benefits that commercial aerospace project managers may derive through awareness of IRS taxation rules and regulations concerning capital equipment, such as depreciation allowances and investment tax credits that can be calculated in terms of 'net present value' (NPV). Together with revenue, costs, and maintenance and salvage value, NPV can be used to determine the total cost of a piece of capital equipment as a function of initial service date. General equations are presented which can be used to determine the penalty associated with a slip in schedules into a subsequent tax year, or the benefits associated with accelerating a schedule into an earlier tax year. O.C.

A87-26031
MANAGING PROJECT TECHNICAL, COST AND SCHEDULE RISKS
ALFRED M. FEILER and ROBERT GEMINDER IN: Institute of Environmental Sciences, Annual Technical Meeting, 32nd, Dallas and Fort Worth, TX, May 6-8, 1986, Proceedings . Mount Prospect, IL, Institute of Environmental Sciences, 1986, p. 52-63. refs

An advanced project risk analysis and management system, PROMAP, based on a modification of the conventional critical path activity network to include network logic and data describing various areas of project uncertainty, is described. Risk analysis focuses on the probability that the activity will be on the derived longest time path during the project. A forward look incorporates the uncertainties regarding future events, and a projected outcome area defines all completion possibilities between the extremes in time and cost performance. A resource risk analysis takes into account the variable start and finish dates of the activities in addition to activity resource requirement uncertainty. The analysis also includes contingency plans and analysis of system support risks. R.R.

A87-26753
WILL SATELLITES AND OPTICAL FIBER COLLIDE OR COEXIST?
ROY A. LAYTON IN: Tracing new orbits: Cooperation and competition in global satellite development . New York, Columbia University Press, 1986, p. 19-29.

The growth in the number of U.S. private communications satellites since the 1960s has been paralleled by the development and installation of fiber optics communications links. Satellite communications are insensitive to distance and require few ground facilities, while fiber optics signals have shorter travel times and do not degrade from precipitation. Several growth scenarios for satellite and optical fiber links are discussed. In the 1990s, continued growth in capacities and the size of different telecommunications companies will exacerbate competition for existing markets and force circuit access use fees downward.

However, as with most new capabilities, the potential markets may only require interpretation by the appropriate entrepreneurs to grow rapidly in number. M.S.K.

A87-26755
INTELSAT - RESPONDING TO NEW CHALLENGES
JOSEPH N. PELTON (Intelsat, Washington, DC) IN: Tracing new orbits: Cooperation and competition in global satellite development . New York, Columbia University Press, 1986, p. 58-74.

Intelsat provides global telecommunications links to 170 countries, currently competing only with fiber optics and submarine cables. Charges for Intelsat links have dropped about 80 percent in the 20 yr of Intelsat existence. The Intelsat decision process provides for checks against any of the 110 signatories who pursue decisions that may adversely affect the financial goals of the organization. Programs and technologies recently implemented by Intelsat to ensure state of the art, lowest-cost telephony, digital television and data transmission services are described. Reasons why private, competitive ventures in Intelsat service areas could reverse Intelsat cost minimization and innovation efforts are discussed. M.S.K.

A87-26756
THE REALITY OF CHANGE, SATELLITE TECHNOLOGY, ECONOMICS, AND INSTITUTIONAL RESISTANCE
CHRISTOPHER J. VIZAS, II IN: Tracing new orbits: Cooperation and competition in global satellite development . New York, Columbia University Press, 1986, p. 75-87.

The Intelsat charter and recent attempts by Intelsat to respond to proposed specialized private satellite communications systems are discussed. Intelsat is currently the sole transoceanic telecommunications carrier. However, the high volume, public switched service that Intelsat supplies causes less-developed nations to construct earth stations costing twice what would be required with specialized technology. A problem also exists when private corporations need dedicated, direct-access links to overseas offices. It is recommended that the governments who are signatories determine if Intelsat can meet these specialized needs, and whether other entities should be allowed to if Intensat cannot. M.S.K.

A87-26760* National Aeronautics and Space Administration, Washington, D.C.
COMMERCIAL SPACE POLICY - THEORY AND PRACTICE
JERRY FREIBAUM (NASA, Washington, DC) IN: Tracing new orbits: Cooperation and competition in global satellite development . New York, Columbia University Press, 1986, p. 156-165. refs

NASA policy toward commercial space ventures is summarized and illustrated with a proposed system for mobile communications through satellite links (MSAT). The government's, i.e., NASA's, role in commercial space ventures is to provide funding and expertise to high risk projects with prospective large returns, provided no vital public services are displaced. MSAT would be realized with a relay spacecraft in GEO, linking mobile radios costing in the range $500-2500. The experimental ATS-6 satellite would be the first generation relay. It is estimated that by the 1990s a spacecraft with a 20-55 m antenna could provide transmission relays for between 640,000 to about 2.5 million nonurban communications units. M.S.K.

A87-28613
WILL THE AEROSPACE PLANE WORK?
STEPHEN W. KORTHALS-ALTES Technology Review (ISSN 0040-1692), vol. 90, Jan. 1987, p. 42-51.

The NASA National Aerospace Plane, proposed in 1986 as a hypersonic transport/single-stage-to-orbit vehicle that would be able to reduce launch costs from $2000/lb to $20/lb on the basis of a straightforward integration of already-existing technology, is presently scrutinized with attention to its most critical component, an airbreathing propulsion system. Primary airbreathing propulsion candidates are supersonic combustion ramjets and air turboramjets. Both civilian and military operational costs are assessed; it is judged that cost improvements over current launchers will at best amount to an order-of-magnitude reduction, rather than the two orders of magnitude initially claimed. The aerospace plane, furthermore, is held to be uneconomical as an air defense system. O.C.

A87-29404
ESA'S ROLE FOR EUROPEAN INDUSTRY
REIMAR LUEST (ESA, Paris, France) IN: Space commerce '86; Proceedings of the International Conference and Exhibition on the Commercial and Industrial Uses of Outer Space, Montreux, Switzerland, June 16-20, 1986 . Geneva, Interavia Publishing Group, 1986, p. 18-27.

ESA member states require that the majority (85-90 pct) of work on large space projects be performed by external contractors. ESA engineers coordinate the work, establish links between contractors and users, and plan and prepare the operations of projects. Direct efforts are needed to ensure that contractors (large companies) employ subcontractors. Contract incentives encourage meeting schedule and budget goals. The tendency for separate countries to initiate large programs, e.g., Spacelab and the Ariane, ensures that a large proportion of project funds flow to that country. Furthermore, large firms merge and/or form consortia, decreasing competition and increasing costs. ESA is fostering commercialization by providing a financial safety net for companies which undertake space ventures, the most successful of which are Arianespace and SPOT. DBS systems are expected to be one of the other near-term successful ventures. M.S.K.

A87-29410
SPACE LAW FOR BUSINESS PROFITS
ART DULA (Dula, Shields and Egbert, Houston, TX) IN: Space commerce '86; Proceedings of the International Conference and Exhibition on the Commercial and Industrial Uses of Outer Space, Montreux, Switzerland, June 16-20, 1986 . Geneva, Interavia Publishing Group, 1986, p. 97-118.

The evolution of national and international space law is traced to the implications of participation in the Space Station and SDI. The effects of space law on U.S. activities is discussed in terms of the international juridical framework, national legal regulations and the political policies of the administration in office. National Commission on Space recommendations regarding U.S. responses to attempts by international organizations to regulate space activities are noted. The DOT now regulates commercial space launches, which are being encouraged, by legislation, by NASA. Participation in SDI is considered from the point of view of security requirements and the ability of European companies to bid on defense contracts on an equal footing with U.S. companies. Technology export control laws which affect potential European SDI contractors are examined, along with the potential for hundreds-of-billions of dollars annual markets in space industries by the year 2000. M.S.K.

A87-29412
INVESTMENT IN SPACE - A FUNCTION OF RISK
WOLFGANG H. DEMISCH (First Boston Corp., New York) IN: Space commerce '86; Proceedings of the International Conference and Exhibition on the Commercial and Industrial Uses of Outer Space, Montreux, Switzerland, June 16-20, 1986 . Geneva, Interavia Publishing Group, 1986, p. 130-135.

The current level of risk associated with private financing of space projects is discussed from the point of view of a banker. Risk assessment is based on estimates of the existing market, the feasibility, the cost, the time to completion, competing capabilities and the business environment created by government policies. Satellite-based telecommunications are a proven investment, while very little data is available for materials processed in space. The total global investment in space science is estimated to be in the tens of millions of dollars. It is recommended that higher funding priorities be given to space-based basic research, the establishment of facilities for long-duration orbital studies, and the development of lower cost launch vehicles, possible including laser propulsion and/or tether skyhooks. M.S.K.

A87-29434
HIGH RISK INVESTMENTS
HERBERT FRANK (ESA, Paris, France) IN: Space commerce '86; Proceedings of the International Conference and Exhibition on the Commercial and Industrial Uses of Outer Space, Montreux, Switzerland, June 16-20, 1986 . Geneva, Interavia Publishing Group, 1986, p. 382-394.

Venture capital financing is examined with an eye to the implications for private funding of space commercialization projects. Venture capital is defined; and attention is given to whether venture capital is a suitable source for financing space activities, and to whether space business is an attractive sector for venture capital investment. Emphasis is placed on the European situation.
M.S.K.

A87-29440
SPACE TECHNOLOGY UTILISATION - THE ROLE OF ESA AND STATE INSTITUTIONS
HEINZ STOEWER (ESA, Systems Engineering Dept., Noordwijk, Netherlands) IN: Space commerce '86; Proceedings of the International Conference and Exhibition on the Commercial and Industrial Uses of Outer Space, Montreux, Switzerland, June 16-20, 1986 . Geneva, Interavia Publishing Group, 1986, p. 458-462.

The roles of ESA, state institutions and private industries in the transfer of space technologies to terrestrial industries and products are discussed. Space projects have become a significant competitor with military activities as the cutting edge of scientific and engineering advancements. Several of the international, private, and quasi-public agencies, such as Eutelsat, Eumetsat, Inmarsat, Intelsat, Arianespace, etc., which have become established operations are cited. Organizations operating free-flying orbital factories, mining lunar and asteroid materials, providing emergency telecommunications, navigation and positioning services, etc., may be formed in the 21st century. Several spinoff technologies are identified: breath analyzers, IR array detectors, and electromagnetic compatibility standards, etc. Limitations on access to ESA data are described, and occasional adaptations of commercial technologies to space applications are noted.
M.S.K.

A87-29457*# Wyle Labs., Inc., El Segundo, Calif.
COST EFFECTIVE MANAGEMENT OF SPACE VENTURE RISKS
RONALD E. GIUNTINI (Wyle Laboratories, El Segundo, CA) and RICHARD E. STORM (NASA, Washington, DC) IN: Aerospace Testing Seminar, 9th, Los Angeles, CA, Oct. 15-17, 1985, Proceedings . Mount Prospect, IL, Institute of Environmental Sciences, 1986, p. 131-136.

The development of a model for the cost-effective management of space venture risks is discussed. The risk assessment and control program of insurance companies is examined. A simplified system development cycle which consists of a conceptual design phase, a preliminary design phase, a final design phase, a construction phase, and a system operations and maintenance phase is described. The model incorporates insurance safety risk methods and reliability engineering, and testing practices used in the development of large aerospace and defense systems. I.F.

A87-29470#
SATISFYING CARGO CUSTOMER REQUESTS AT LOWER COSTS
CLYDE T. BOLEN, JR. (Lockheed Space Operations Co., Lompoc, CA) IN: Aerospace Testing Seminar, 9th, Los Angeles, CA, Oct. 15-17, 1985, Proceedings . Mount Prospect, IL, Institute of Environmental Sciences, 1986, p. 247-249.

Space Shuttle Operations will soon be a realization at Vandenberg Air Force Base. Primary objective is the delivery of high tech cargo into space. The Vandenberg facilities offer every prospective cargo some very unique capabilities, and a high priority has been given in the development of these facilities to satisfy the cargo customer. Efficiencies are being pursued to keep processing costs low by not requiring extensive unique installations for a particular cargo mission. This paper will address the Vandenberg capabilities available to the cargo customer and encourage cargo designers to take advantage of these generic Vandenberg facilities to realize a lower cargo processing cost.
Author

A87-30757
COMMERCIAL SATELLITE COMMUNICATIONS SYSTEMS - YEAR 2000
G. HYDE and C. E. MAHLE (COMSAT Laboratories, Clarksburg, MD) IN: ICC '86; Proceedings of the International Conference on Communications, Toronto, Canada, June 22-25, 1986, Conference Record. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1986, p. 808-812. COMSAT-sponsored research. refs

The current state and future status of communications satellite systems are studied. Consideration is given to fixed and mobile satellite systems and broadcast satellite services (BSSs). Advances in MMICs, VLSICs, VHSICs, channel multiplication, source encoding, transmission processing, and data protocol are proposed. The design of a future communications satellite is described, and a diagram is provided. Research in the area of satellite antennas, on-board processing, mobile satellite services, BSSs, and earth stations is discussed. The effect of fiber optics on communications satellites is evaluated. I.F.

A87-31375
BALANCING THE NATIONAL INTEREST: U.S. NATIONAL SECURITY EXPORT CONTROLS AND GLOBAL ECONOMIC COMPETITION
Washington, DC, National Academy Press, 1987, 334 p. No individual items are abstracted in this volume.

The effectiveness of U.S. Government technology export controls in fulfilling their stated goals of (1) promoting Free-World economic vitality, (2) maintaining and stimulating the U.S. technology base, and (3) impeding Warsaw-Pact acquisition of militarily useful technology is assessed, reporting the results of a study by the Panel on the Impact of National Security Controls on International Technology Transfer established by the Committee on Science, Engineering, and Public Policy. The need for export controls (due to continuing Soviet intelligence efforts to obtain technology) is demonstrated; the changing global technology market is characterized; the administrative procedures involved in applying the controls in the U.S. and cooperating with CoCom (Coordinating Committee on Multilateral Export Controls) countries are described; and the Panel findings and recommendations are presented in detail. It is argued that the present emphasis on goal (3) and a lack of consistency and direction in applying the controls adversely affect both the achievement of goal (2) and relations with CoCom allies. Stronger CoCom mechanisms (but with more liberal controls within CoCom) and a balanced-goals domestic approach led by the executive branch are recommended. T.K.

A87-32460
COMMERCIALIZATION OF SPACE - THE INSURANCE IMPLICATIONS
BRIAN STOCKWELL and PATRICK OFLAHERTY (Corroon and Black Inspace, Inc., Washington, DC) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2 . Tokyo, AGNE Publishing, Inc., 1986, p. 1365-1372.

The extent of private sector participation in the commercialization of space will be substantially influenced by the availability and cost of insurance. At present, full insurance costs over the lifetime of a communications satellite may amount to an additional 50 percent or more of the cost of construction and launch. The impact of satellite losses in 1984-1985 led to a reduction of insurance capacity from $250 million to less than $100 million. An evaluation is presently made of the space insurance cost and availability prospects for the 1990s; governmental participation in insurance; the cost tradeoffs between increased design, testing, and redundancy by comparison to

attendant reductions in insurance needs and costs; and alternatives to traditional space insurance. O.C.

A87-32600
THE MARKET POTENTIAL OF FUTURE SUPERSONIC AIRCRAFT
RAYMOND A. AUSROTAS (MIT, Cambridge, MA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 7 p. refs
(SAE PAPER 861684)

The X-31 hypersonic vehicle being studied by the U.S. is expected to run $3-20 billion in total development costs before it flies near the turn of the century. The factors which control the economical use of such an aircraft by commercial operators, e.g., the number of passengers and the speed at which the aerospaceplane flies, are examined. The X-31 program was initiated to cut by at least a third the travel time to Pacific rim countries, which are expected to become increasingly more important economically in the next two decades. Similarities between projected demands for aerospaceplane services and those made for the Concorde to garner government financing of that aircraft are discussed, noting that the Concorde will never become economical to operate. However, the aerospace plane will be ready for production when the current generation of large, long range transport aircraft are ready for replacement. M.S.K.

A87-32624
FORECASTING (21ST CENTURY) PRODUCTION COSTS OF ADVANCED SPACE SYSTEMS
ALLAN FORSTER (Aerospace Corp., El Segundo, CA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 16 p.
(SAE PAPER 861762)

Life cycle cost estimates are made for an architecture (family) consisting of advanced space systems. An evaluation of the acquisition phases indicates that a very large percentage of these costs occur in manufacturing. A review of the costing methodology utilized in unit production costs indicates that the data base does not reflect the type of advanced manufacturing processes that would exist when the space systems become operational (in the 21st century). A review is made of the attributes of the factory of the future, and the impact it could have on current cost models used in planning program budgets. Several examples are presented to show the unit production cost saving obtainable when advanced manufacturing processes are applied to high technology areas such as mechanical and electrical space systems, and microelectronic applications (i.e., data processor). The overall implication is that cost reductions up to an order of magnitude are possible in the near time frame if these advanced manufacturing processes are initiated in a revolutionary, rather than an evolutionary manner. Author

A87-33475
LIVING IN SPACE: A HANDBOOK FOR SPACE TRAVELLERS
PETER SMOLDERS (Wonen in de ruimte, Bussum, Netherlands, Unieboek, 1985) Blue Ridge Summit, PA, Tab/Aero, 1986, 159 p. Translation.

The state of the art in manned space flight as of 1985 is surveyed and illustrated with extensive drawings and photographs, with an emphasis on the on-orbit living conditions and activities of astronauts on the Space Shuttle and the planned Space Station. Consideration is given to the Shuttle launch facilities; the Shuttle Orbiter; a typical mission profile; the habitat modules for the Space Station; eating, drinking, sleeping, etc. in space; space manufacturing; past Salyut, Skylab, and Spacelab missions; and proposals for colonizing the moon, Mars, and Venus. T.K.

A87-34595
ADVANCES BY THE SOVIET UNION IN SPACE COOPERATION AND COMMERCIAL MARKETING MADE 1986 A LANDMARK YEAR
JEFFREY M. LENOROVITZ Commercial Space (ISSN 8756-4831), vol. 2, no. 4, Winter 1987, p. 20-22.

A review is presented of the Soviet Union's new campaign for openness as it applies to planned space missions, new cooperation in space, and commercial marketing moves made public during 1986. It was exemplified when the head of the Soviet's Space Research Institute addressed an audience in the Sistine Chapel in 1986 giving detailed findings of the two Vega spacecraft from their encounter with Halley's comet. The Soviet Union is planning a Mars/Phobos mission in 1988, using two spacecraft on Proton launch vehicles. Other missions in the planning phase include Vesta flights to Mars and asteroid/comet targets in the 1990s and a lunar polar orbiter; the Vesta mission was proposed by France as one that could be conducted in cooperation with ESA. Solar-terrestrial missions - Interbol, Prognoz, Relicht 2 - are mentioned. Cooperative space science opportunities are being offered aboard Mir - a large modular manned space station operational in 1987. Commercially, the Soviets are prepared to orbit the Gorizont satellite, with six 6/4-GHz transponders, one 14/11-GHz transponder, and a 1.6/1.5-GHz transponder, and lease its communications capacity to a commercial user. Proton launch vehicle services for communications satellites are being offered at the rate of $24 millin per metric ton ($43 million for two tons), payable in Swiss francs. D.H.

A87-34650#
FRANCE'S SILVER ANNIVERSARY IN SPACE
PIERRE LANGEREUX Aerospace America (ISSN 0740-722X), vol. 25, April 1987, p. 50-54, 56, 58, 60, 62.

A comprehensive account is given of the activities over the past 25 years of the French space agency CNES, begining with the November 1965 launching of a 38-kg capsule into orbit by means of a Diamant booster; Diamant went on to launch 10 French science and technology satellites and the first German satellite, Dial/Wika. Domestic booster development was deemphasized in 1975 when France became an active participant in the ESA, nearly half of whose budget it presently supplies. CNES is also actively cooperating with the USA and USSR. Current major space systems being managed by CNES encompass Telecom 1 communications, SPOT remote sensing, Meteosat meteorology, and Argos and Sargos localization and search-and-rescue. O.C.

A87-34675
CHINA - IN BUSINESS AND ADVANCING FAST
PHILLIP S. CLARK Spaceflight (ISSN 0038-6340), vol. 29, Feb. 1987, p. 62-73. refs

The Chinese space program and Chinese space activities are reviewed. Attention is placed on launch sites, launch vehicles, the operations of satellite STW F-2, the earth observation mission, the communications satellite STW F-3, and the recoverable satellite SKW-14. Consideration is given to future space flight plans (manned flights); launch vehicle developments; multiple payloads; observation, communications, and meteorological satellites; and the commercial potential of the Chinese launch vehicles. I.F.

A87-36280
THE COST EFFECTIVENESS OF WEIGHT REDUCTION BY ADVANCED MATERIAL SUBSTITUTION
PAUL W. SCOTT (Douglas Aircraft Co., Long Beach, CA) SAWE, Annual Conference, 45th, Williamsburg, VA, May 12-14, 1986
17 p
(SAWE PAPER 1693)

Generalized relationships are derived to analyze the cost effectiveness of weight reduction obtained by substitution of an advanced material of reduced density with no change in dimensions. The relationships are applied to a preliminary assessment of aluminum-lithium on an advanced derivative of the MD-80 transport aircraft. This parametric method provides a greater visibility on the material cost considerations than a case-by-case

approach, but nonrecurring costs must be omitted. To obtain a better understanding of the material utilization parameter, 70 production aircraft components fabricated from plate, sheet, extrusions, conventional forgings, and precision forgings are analyzed. With reduced cost premiums and improved utilization, many components fabricated from plate, heavily machined extrusions, and conventional forgings could become cost effective applications for Al-Li. The net value of the weight reduction provided by applications with low material utilization, however, will be significantly offset by the added material expense. Material utilization data are tabulated for MD-80 and DC-10/KC-10 aircraft structural elements. D.H.

A87-36306
THE CRITICAL MEASURE OF SPACE TRANSPORTATION EFFECTIVENESS
SANDRA L. WITT (General Dynamics Corp., Space Systems Div., San Diego, CA) SAWE, Annual Conference, 45th, Williamsburg, VA, May 12-14, 1986. 11 p. refs
(SAWE PAPER 1746)

Early assessment of space transportation costs has become an integral step in the evaluation of future systems, and new emphasis on cost is influencing plans for investments in advanced technology, significantly affecting vehicle design. To minimize the life-cycle cost of these vehicles, cost drivers must be isolated and the sensitivity of life-cycle cost to these parameters must be identified. Tools used for the assessment and a reduction of system cost must evolve to respond quickly and accurately to questions raised in early design configuration studies. Integrating the tasks performed by mass properties engineers is an essential requirement for standardizing the tools used for configuration development and for providing the database required for effective control of program costs. Attention is given to the case of the space-based orbital transfer vehicle (OTV). D.H.

A87-41218
RECONSTITUTING THE US SPACE PROGRAMME
JOHN M. LOGSDON (George Washington University, Washington, DC) Space Policy (ISSN 0265-9646), vol. 3, May 1987, p. 86-88.

Proposals to reconstitute the U.S. civilian space program are briefly discussed, with an emphasis on political and economic factors. The symbolic nature of the space program (as a way of demonstrating national power and technological competence) is found to be as important today as it was at the establishment of NASA in 1958 and at the inception of the Apollo program in 1961. It is argued that current NASA funding (about $9 billion per year) is sufficient for a space program comprising projects carefully selected to fulfill these symbolic aims. The elements of such a program include renewal of the technology base to assure access to space for all purposes, appropriate use of the Space Shuttle, a significant role for humans in space, a perceived future for space science and exploration, and a Space Station with broad international participation. T.K.

A87-41220
REBUILDING U.S. LAUNCH CAPABILITIES
HENRY R. HERTZFELD Space Policy (ISSN 0265-9646), vol. 3, May 1987, p. 100-103.

The 1986 decision by the U.S. government to terminate the commercial availability of the Space Shuttle and thus stimulate the domestic aerospace industry to develop commercial launch services is examined critically, and alternative strategies are proposed. It is argued that the growing global availability of launchers, subsidization of launcher programs in many countries, the well-established and continuing dependence of U.S. industry on NASA and military contracts, the fragmentation of industry capabilities (with no one company producing a full line of vehicles), and the specialized nature of currently available launchers all make it unlikely that the stimulation policy will succeed. The formation of a quasi-governmental corporation to serve both commercial users and DOD needs is proposed. This corporation would be funded by stock sales to the public, government contribution of hardware and facilities in exchange for equity shares, and industry investment. T.K.

A87-45208#
LIBERTY - A LOW-COST, COMMERCIAL EXPENDABLE LAUNCH VEHICLE
GARY C. HUDSON and MAXWELL W. HUNTER, II (Pacific American Launch Systems, Inc., Redwood City, CA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 7 p. refs
(AIAA PAPER 87-1794)

A commercial, low-cost launch vehicle is proposed. The vehicle, known as Liberty II, would employ a pressure-fed first stage and a pump-fed second stage. Payloads in the 25,000-pound range could be placed into LEO, while up to 7,000-8,000 pounds could be injected into GTO. Cost per flight is estimated to be $25 million in small quantities, leading to a $400-600 per pound tariff when launched in large numbers (more than 10/year) to LEO. Author

A87-45211#
SUPPLY AND DEMAND IN THE COMMERCIAL SPACE-LAUNCH MARKETPLACE
DAVID BENTON (ANSER, Arlington, VA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 6 p.
(Contract F49620-86-C-0047)
(AIAA PAPER 87-1799)

The commercial space-launch market is characterized by long lead times, high technical risk, a small number of suppliers, and sensitivity to changes in government policy. This results in a singularly inefficient market. The paper quantifies supply and demand functions for the commercial space-launch market and compares the competitive position of alternative suppliers. The implications for other U.S. commercial interests and industries are developed and, from this, the overall potential of the U.S. commercial space-launch industry is explored in relation to the major international competitors. The analysis shows that there is sufficient commercial demand to support new U.S. entrants into the commercial space-launch market - if they can compete in terms of price and reliability. If these entrants do not appear, the U.S. satellite and telecommunications industries could experience adverse effects. Author

A87-46875
WE SHOULDN'T BUILD THE SPACE STATION NOW
ALEX ROLAND (Duke University, Durham, NC) Technology Review (ISSN 0040-1692), vol. 90, July 1987, p. 22, 23.

The present evaluation of the goals and resources of the U.S. space program notes that the construction of a Space Station enjoys only narrow support beyond NASA and the aerospace industry, in the scientific and engineering communities that would be expected to make the greatest use of it. In addition, it is argued that the first phase of Space Station construction will cost far in excess of the $13 billion estimated in April 1987 and be completed significantly later that the 1996 date projected. The Space Station is further alleged to constitute a drain on NASA funds that will starve more productive programs concerned with space science experimentation, and invite more intensive military participation and funding, thereby further complicating the already problematic legal aspects of space use. O.C.

A87-48053
COST EFFECTIVE AVIONICS - CUSTOMER'S VIEWS: EXPERIENCE WITH CIVIL AIRCRAFT
J. MILLS (British Airways, London, England) IN: Cost-effective avionic and weapon systems; Proceedings of the Spring Convention, London, England, May 14, 15, 1986 . London, Royal Aeronautical Society, 1987, p. 2.1-2.7.

The cost of civilian aircraft avionics encompasses initial procurement costs, the cost of support spares, the cost of carrying the avionic system's weight, periodic maintenance, and original development costs. An assessment of development trends seen in recent and state-of-the-art civil aircraft avionics points to: the

integration of conventionally separate systems into single units, as in full authority digital engine control systems; the simultaneous use of satellites for both communication and navigation, and even for passenger telephony; the incorporation of entire avionic systems in the form of software 'file cards', rather than black boxes; and the use of fiber-optic circuits in avionics. O.C.

A87-48062
REAL COST SAVINGS THROUGH STANDARD INTERFACE HARDWARE
RICHARD A. DE VERTEUIL (GEC Avionics, Ltd., Rochester, England) IN: Cost-effective avionic and weapon systems; Proceedings of the Spring Convention, London, England, May 14, 15, 1986 . London, Royal Aeronautical Society, 1987, p. 11.1-11.9.

The adoption of comprehensive and detailed standards for high speed, multiplexed digital bus technology has resulted in dramatic weight and complexity reductions in aircraft wiring, and the establishment of data protocols has simplified the interfacing of user systems. Because component-level standards ensure similarity of performance, they allow multiple-manufacturer sourcing for the achievement of more competitive prices. At integrated-product level, the resulting interchangeability of equipment once more facilitates competitive practices among manufacturers and compatibility among different sources' spare parts, with attendant maintenance cost reductions. O.C.

A87-48580#
JAPANESE CUSTOMER NEEDS FOR SPACE STATION
K. HIGUCHI, I. IIZUKA, and Y. FUJIWARA (National Space Development Agency of Japan, Tokyo) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 10 p.
(AIAA PAPER 87-2193)

Results from mission analysis in communications, the requirements of Japanese customers, and the Japanese Experiment Module Information System (JEMIS) are discussed. Mission objectives include: scientific observation, earth observation, communications, materials processing and production, life science, and technology development. The data exchange between the Japanese Experiment Module (JEM) and the ground was analyzed; it is determined that experimental, computer voice, video, and real and nonreal time data are required for the communications missions. A cosmic gamma ray burst, space energy, and test of sensor technologies experiments will be conducted to define the capacity of data transmissions. The JEMIS will provide payload operation support functions and increase JEM operation while retaining operating flexibility. The main elements of the information system, its functions, and JEMIS data transmission requirements are described. Diagrams of the JEMIS are presented. I.F.

A87-48771
SELECTED PROBLEMS IN THE DECISION MAKING PROCESS FOR FUTURE SMALL TRANSPORT/UTILITY AIRCRAFT
JOHANNES SPINTZYK and GERHARD BEHRENDT (Dornier GmbH, Friedrichshafen, West Germany) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr. 28-30, 1987. 12 p. refs
(SAE PAPER 871045)

An aircraft company undertaking a new aircraft development program faces complex problems such as financial risks, prediction of future market development, implementation of advanced technologies, economics/prices, and production cost. In the present paper, the regional aircraft market is discussed with emphasis placed on return on investment and modern cost-saving production methods. It is noted that allowance must be made for certain unforeseeables such as oil crises, natural catastrophes, and the influence of terrorism. K.K.

A87-49897
ON-BOARD PROCESSING FOR COMMUNICATIONS SATELLITE SYSTEMS - SYSTEMS AND BENEFITS
P. P. NUSPL, R. PETERS, and T. ABDEL-NABI (INTELSAT, Washington, DC) IN: ICDSC-7; Proceedings of the Seventh International Conference on Digital Satellite Communications, Munich, West Germany, May 12-16, 1986 . Berlin, West Germany, VDE-Verlag GmbH, 1986, p. 137-148. refs

The paper discusses on-board processing systems and benefits including connectivity, increased capacity, lower costs and system improvements; there are complex trade-offs in designs. Several architectures are described and use a microwave switch matrix, baseband switch matrix or baseband processor. On-board regeneration consists of demodulation followed by remodulation; this provides access to baseband signals. The link advantages are clearly presented for 120 Mbit/s TDMA and for IBS at 1.544 Mbit/s. There are discussions of five (5) architectures using multicarriers per transponder, their advantages and disadvantages. Some considerations of using on-board decoding and baseband processing functions are briefly presented. Author

A87-50793
SOVIET SPACE CAPABILITY - BIG SURPRISES COMING?
Space Markets (ISSN 0258-4212), Autumn 1986, p. 176-182.

Likely future developments in Soviet space flight are discussed. New Soviet vehicles anticipated by the DOD are described. These are the SL-X-16, the SL-W, and a winged space plane similar in size to the U.S. Shuttle orbiter. It is assumed that the core stage of the SL-W will employ cryogenic propellants; it is believed that the six-booster variant could put 150 tons into a 180 km low orbit, while the four-booster version would be limited to 1000 tonnes. The possible industrialization of the GEO orbit by the USSR is examined with attention given to ground illumination from space, power transmission via space, energy generation for space operations, and space power for transmission to earth. K.K.

A87-51318
NEW LIFE FOR EXPENDABLE LAUNCHERS
RAMON L. LOPEZ and GREG WASKUL Space Markets (ISSN 0258-4212), Spring 1987, p. 4-10.

The U.S. commercial expendable launch vehicle (ELV) industry is examined. The use of Titan, Delta, Atlas-Centaur, and Liberty boosters to launch domestic and foreign commercial payloads is analyzed. The ELV commercialization agreement which explains the division of liability between the parties is described. Consideration is given to the competition to the U.S. industry from Europe's Ariane, China's Long March, and the Soviet Proton launchers. I.F.

A87-51322
AVIATION SATCOMS
CHRIS BULLOCH Space Markets (ISSN 0258-4212), Summer 1987, p. 60-66.

The ARINC and Inmarsat approaches to the development of aeronautical satellite communications are described. The ARINC approach involves obtaining the support of users prior to developing the service, and Inmarsat's goal is to launch its communications system and obtain users by proving the system's technical and economic viability. The use of an aeronautical satellite communication system for passenger communications is discussed. The designs and capabilities of the ARINC and Inmarsat aeronautical satellite communications systems are examined. I.F.

A87-51324
EURIMAGE SETS UP SHOP
CHRIS BULLOCH Space Markets (ISSN 0258-4212), Summer 1987, p. 95-98.

The structure and functions of Eurimage, a group concerned with the distribution of image data obtained from earth observation satellites, are described. Providing the data to the users as quickly as possible is the primary objective of the group; the principal users of the satellite images are national organizations and

government agencies concerned with agriculture, soil analysis, and land use. Various applications for Landsat images are discussed. I.F.

A87-53095
SATELLITE COMMUNICATIONS AND BROADCASTING; PROCEEDINGS OF THE INTERNATIONAL CONFERENCE, LONDON, ENGLAND, DEC. 2-4, 1986
London, Online Publications, 1986, 200 p. For individual items see A87-53096 to A87-53100.

Papers are presented on private satellite networks in the U.S.; the competitive market for international satellite services; private satellite networks in Europe; and various applications for satellites, in particular data broadcasting and business communications. Topics discussed include the worldwide regulation of satellite broadcasting and communications; the capabilities of Eutelsat II; trends in satellite technology; and the role of insurance in space industries. Consideration is given to the use of the ASTRA satellite for TV broadcasting; the services provided by Intelsat; the evolution of American television due to satellites; consumer satellite Television Receive Only marketing in Europe; and satellite programming. I.F.

A87-53100
DEVELOPING THE BUSINESS - THE ROLE OF INSURANCE
BRIAN R. YEOMANS (C. T. Bowring Space Projects, Ltd., London, England) IN: Satellite communications and broadcasting; Proceedings of the International Conference, London, England, Dec. 2-4, 1986 . London, Online Publications, 1986, p. 121-129.

The future use of insurance in the space industry is discussed. Who requires insurance, the cost of premiums, and the need for the space industry to improve launcher and satellite designs are considered. The role of the entrepreneur, whether the insurer or client, in the development of a viable space insurance market is examined. Various means of solving the problems between insurers and the space industry are proposed. I.F.

A87-53989
LEADERSHIP IN SPACE TRANSPORTATION
JOEL S. GREENBERG (Princeton Synergetics, Inc., NJ) Space Policy (ISSN 0265-9646), vol. 3, Aug. 1987, p. 179, 180.

The role of the U.S. government, through its civilian space program, in promoting the competitiveness of U.S. marketers of commercial launch services (CLSs) is discussed. The need to concentrate R&D efforts and funding in specific areas (rather than aiming for overall preeminence in space) is indicated, and the competition faced by the U.S. CLS industry in the global market is briefly characterized. It is argued that U.S. CLS marketers would have a distinct advantage if they could offer customers access, on a contractual basis, to the unique on-orbit experimentation and maintenance/repair capabilities of the Space Shuttle and Space Station. It is recommended that long-term commercial and economic factors be given more weight when international cooperation agreements are negotiated. T.K.

N87-13358*# Denver Univ., Colo.
THE UNCOUNTED BENEFITS: FEDERAL EFFORTS IN DOMESTIC TECHNOLOGY TRANSFER
R. L. CHAPMAN and K. HIRST Jul. 1986 366 p
(Contract NASW-3466)
(NASA-CR-177044; NAS 1.26:177044) Avail: NTIS HC A16/MF A01 CSCL 05A

Organized technology transfer activities conducted by the agencies of the U.S. government are described. The focus is upon agency or departmental level activity rather than the laboratory level. None of the programs on which information was collected has been assessed or evaluated individually. However, the aggregate programs of the government have been judged in terms of obvious gaps and opportunities for future improvement. An overview, descriptions of the various agency or department programs of technology transfer, a list of persons interviewed or consulted during the survey, and a bibliography of publications, reports and other material made available to the study staff are given. An extensive appendix of illustrative material collected from the various programs is also given. Author

N87-13600*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ASSESSMENT OF THE STATUS AND TRENDS IN SATELLITE COMMUNICATIONS 1986-2000: AN INFORMATION DOCUMENT PREPARED FOR THE COMMUNICATIONS SUBCOMMITTEE OF THE SPACE APPLICATIONS ADVISORY COMMITTEE
W. A. POLEY, G. H. STEVENS, S. M. STEVENSON, J. LEKAN, C. H. ARTH, J. E. HOLLANSWORTH, and E. F. MILLER Nov. 1986 102 p
(NASA-TM-88867; E-3270; NAS 1.15:88867) Avail: NTIS HC A06/MF A01 CSCL 45O

This is a response to a Space Applications Advisory Committee (SAAC) request for information about the status and trends in satellite communications, to be used to support efforts to conceive and recommend long range goals for NASA communications activities. Included in this document are assessments of: (1) the outlook for satellite communications, including current applications, potential future applications, and impact of the changing environment such as optical fiber networks, the Integrated Services Digital Network (ISDN) standard, and the rapidly growing market for Very Small Aperture Terminals (VSAT); (2) the restrictions imposed by our limited spectrum resource; and (3) technology needs indicated by future trends. Potential future systems discussed include: large powerful satellites for providing personal communications; VSAT compatible satellites with onboard switching and having voice capability; large satellites which offer a pervasive T1 network service (primarily for video-phone); and large geostationary communications facilities which support common use by several carriers. Also, discussion is included of NASA particular needs and possible future systems. Based on the mentioned system concepts, specific technology recommendations are provided for the time frames of now - 1993, 1994 - 2000, and 2000 - 2010. Author

N87-15381# Mobile Satellite Corp., King of Prussia, Pa.
THE UNITED STATES MOBILE SATELLITE SERVICE
J. D. KIESLING *In* ESA Proceedings of an ESA Workshop on Land Mobile Services by Satellite p 95-98 Sep. 1986
Avail: NTIS HC A08/MF A01

The proposed U.S. mobile satellite service provides services to America's nonurban land mass where terrestrial mobile systems find little application. Based on state of the art satellite technology, and use of omnidirectional, steered, and fixed antennas, a broad range of services at affordable prices will be available, including land mobile, service to intra coastal waterways, and aviation. ESA

N87-17177# Earth Observation Satellite Co., Va.
COMMERCIAL OPPORTUNITIES IN EARTH OBSERVATION FROM SPACE
C. P. WILLIAMS *In* ESA Proceedings of the 1986 International Geoscience and Remote Sensing Symposium (IGARSS '86) on Remote Sensing: Today's Solutions for Tomorrow's Information Needs, Volume 1 p 73-76 Aug. 1986
Avail: NTIS HC A99/MF E03; ESA, Paris, France, 3 volume set $90 Member States, AU, CN, and NO (+20% others)

Land and ocean remote sensing programs are listed. The LANDSAT and SPOT instruments are described. Commercial prospects for the 21st century are considered. ESA

N87-17800*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MANNED MARS MISSION COST ESTIMATE
JOSEPH HAMAKER and KEITH SMITH *In its* Manned Mars Mission. Working Group Papers, V. 2, Sect. 5, App. p 936-950 May 1986
Avail: NTIS HC A24/MF A01 CSCL 05C

The potential costs of several options of a manned Mars mission are examined. A cost estimating methodology based primarily on

existing Marshall Space Flight Center (MSFC) parametric cost models is summarized. These models include the MSFC Space Station Cost Model and the MSFC Launch Vehicle Cost Model as well as other modes and techniques. The ground rules and assumptions of the cost estimating methodology are discussed and cost estimates presented for six potential mission options which were studied. The estimated manned Mars mission costs are compared to the cost of the somewhat analogous Apollo Program cost after normalizing the Apollo cost to the environment and ground rules of the manned Mars missions. It is concluded that a manned Mars mission, as currently defined, could be accomplished for under $30 billion in 1985 dollars excluding launch vehicle development and mission operations. Author

N87-19144*# Denver Research Inst., Colo. Industrial Economics and Management Div.
NASA PARTNERSHIP WITH INDUSTRY: ENHANCING TECHNOLOGY TRANSFER
Jul. 1983 290 p
(Contract NASW-3466)
(NASA-CR-180163; NAS 1.26:180163) Avail: NTIS HC A13/MF A01 CSCL 05A

Recognizing the need to accelerate and expand the application of NASA-derived technology for other civil uses in the United States, potential opportunities were assessed; the range of benefits to NASA, industry and the nations were explored; public policy implications were assessed; and this new range of opportunities were related to current technology transfer programs of NASA. B.G.

N87-20626# Centre National d'Etudes Spatiales, Toulouse (France). SPOT IMAGE.
REMOTE SENSING APPLICATIONS: COMMERCIAL ISSUES AND OPPORTUNITIES FOR SPACE STATION
G. BRACHET *In* ESA Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 35-37 Nov. 1986
Avail: NTIS HC A07/MF A01

The SPOT program is reviewed and the long term prospects beyond SPOT-4 are assessed. Management, legal, and commercial aspects are emphasized. ESA

N87-28012# International Trade Administration, Washington, D.C.
COMPETITIVE ASSESSMENT OF THE US ROBOTICS INDUSTRY
Mar. 1987 96 p
(PB87-188363) Avail: NTIS HC A05/MF A01 CSCL 13I

Robots are becoming increasingly important to U.S. manufacturers as a means to increase productivity and manufacturing flexibility, and reduce product costs. New robot orders escalated rapidly in the period 1983 to 1985. Robot purchases were essentially flat in 1986, and industry observers predict as much as a 20 percent decline for 1987. Japan supplies 80 percent of the U.S. robot imports. Many U.S. firms marketing robots have found it cost effective to import basic robots, focusing their engineering and research and development efforts on the development of accessories and peripherals that enhance end use applications. Japan dominates the world robot market, with over half of total world production. Sales by U.S. producers lag far behind those by major Japanese producers, and European producers such as the Swedish firm ASEA, which alone accounts for 9 percent of world robot sales. Producers in Japan and Europe are concentrating on closing any technological gaps in areas where they lag U.S. producers. Where they are ahead in some areas, they are extending their lead over U.S. suppliers. GRA

08

LOGISTICS AND OPERATIONS MANAGEMENT

Includes Inventory Management and Spare Parts, Materials Management and Handling, Resources Management, Resource Allocation, Procurement Management, Leasing, Contracting and Subcontracting, Maintenance and Repair, Transportation, Air Traffic Control, Fuel Conservation, Operations, Operational Programs.

A87-11805#
PROJECT MANAGEMENT SUPPORT
D. A. HARTEL (ARINC Research Corp., National Airspace Systems Div., Annapolis, MD) IN: Radio Technical Commission for Aeronautics, Annual Assembly Meeting and Technical Symposium, Washington, DC, November 19-21, 1985, Proceedings . Washington, DC, Radio Technical Commission for Aeronautics, 1985, p. 99-106.

The functions and activities of the Project Management Support (PMS) group, which was established to ensure that the technical, schedule and cost objectives of the 90 projects of the National Airspace System Plan are accomplished are described. The PMS personnel come from private industry and the Federal government. The group reviews and documents technical specifications, implements management control systems for individual and interdependent projects, devises critical path schedules for the various projects, and provides logistics support, including audits of project contractors. Also, the PMS on occassion provides technical direction, i.e., guidance on the interpretation of technical specifications. The functions of the group are illustrated through a description of activities for the NADIN II data switching resources project for establishing a packet-switched network for data communications in the NAS. M.S.K.

A87-14352* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ALL-DIGITAL JETS ARE TAKING OFF
C. R. SPITZER (NASA, Langley Research Center, Hampton, VA) IEEE Spectrum (ISSN 0018-9235), vol. 23, Sept. 1986, p. 51-56. refs

The functions and advantages of second-generation digital avionics systems are described. These digital systems have increased integration, increased reliability and flexibility, and improved man-machine interface, and they provide increases in the mean time between removal of line-replacable units and fuel savings. Different redundant processors and software are utilized to achieve fault-tolerance performance of flight control systems. The improved landing capabilities, front-panel instruments, sidestick controllers, back-lighted liquid-crystal displays, and fly-by-wire system possible with digital avionics are examined. The applications of digital avionics to military and commercial aircraft are discussed and examples are provided. I.F.

A87-15900*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE POWER - EMERGING OPPORTUNITIES
H. W. BRANDHORST (NASA, Lewis Research Center, Cleveland, OH) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 8 p.
(IAF PAPER 86-152)

NASA programs directed towards the development of technologies to meet the cost-effective energy needs of future space missions are described. Consideration is given to the space photovoltaic program, which was developed along two paths: one leading to high-performance ultralight weight solar arrays, the other to high output arrays. The space power materials and energy storage technology are discussed, together with the developmental aspects of an advanced solar dynamic power system and its subsystems. Special attention is given to the Nasa SP-100 Advanced Technology Project and the free-piston Stirling engine technology for nuclear power application. I.S.

A87-16398
US AIR TRANSPORT TECHNOLOGY - WHERE NEXT?
D. LEARMOUNT Flight International (ISSN 0015-3710), vol. 130, Aug. 30, 1986, p. 120-122, 124, 128.

An evaluation is made of the fuel-choice and thermodynamic-cycle-efficiency issues raised by the hypersonic airliner, as well as to the powerplant configuration and airframe materials choices under consideration for the next-generation subsonic airliners. The structural performance improvements and difficulties encountered to date with aluminum-lithium alloys and thermoplastic composite matrices are discussed. The strongest selling point of the 'Orient Express' hypersonic airliner is its completion of a Los Angeles-Sydney flight in less than 2.5 hr; the development cost and small production runs anticipated for this aircraft, however, are projected to make financing prohibitively expensive. O.C.

A87-16932*# National Aeronautics and Space Administration, Washington, D.C.
THE INTERNATIONAL TEAM
R. V. LOTTMANN, L. D. WIGBELS (NASA, Washington, DC), and W. E. RICE (NASA, Johnson Space Center, Houston, TX) Aerospace America (ISSN 0740-722X), vol. 24, Sept. 1986, p. 56-58.

In view of the limited resources anticipated for the initial stages of the NASA Space Shuttle program, NASA planners have proposed a multinational partnership concept which will attempt to meet user requirements with minimum duplication of facilities and equipment. A major aspect of this concept is that the assignment of functions to as given country's laboratory module only implies that its subsystems will be tailored as necessary to the accommodation of such functions; the outfitting of the laboratory with research equipment will then be shared by all partners. O.C.

A87-17842*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPANION - AN ECONOMICAL ADJUNCT TO THE SPACE SHUTTLE
J. A. MARTIN (NASA, Langley Research Center, Hampton, VA) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 23, Sept.-Oct. 1986, p. 541, 542.

A 'Companion' system which would operate with the Space Shuttle to provide lower cost transportation is proposed. The companion system operation would involve launching simultaneously with the Shuttle, booster fly back to the launch site for reuse, payload delivery, rendezvous with the Shuttle, and reentry in the payload bay of the Orbiter. The disadvantages of this system are that the Orbiter could return only the Companion in its payload bay and the Orbiter may need to remain in orbit extra days; however, the economic benefits of the system are significant. It is estimated that the system could deliver a payload and shroud mass of about 10,000 kg into low earth orbit. I.F.

A87-17891#
THE ASSOCIATE CONTRACTOR APPROACH TO SYSTEM INTEGRATION
G. P. BURBEY (Rockwell International Corp., Los Angeles, CA) AIAA, AHS, and ASEE, Aircraft Systems, Design and Technology Meeting, Dayton, OH, Oct. 20-22, 1986. 6 p.
(AIAA PAPER 86-2632)

A87-18125
POWER SYSTEM AUTONOMY
J. J. CAPULLI, J. H. HAYDEN, and P. S. GOSHGARIAN (Hughes Aircraft Co., Space and Communications Group, El Segundo, CA) IN: IECEC '86; Proceedings of the Twenty-first Intersociety Energy Conversion Engineering Conference, San Diego, CA, August 25-29, 1986. Volume 3 . Washington, DC, American Chemical Society, 1986, p. 1757-1762.

Development tasks for the wide-scale implementation of power system autonomy are presented. It is shown that battery management is currently the area most in need of autonomy. It is concluded that subsystem control using digital microprocessor technology in tandem with analog circuitry as a primary control provides high reliability for systems that require a high level of autonomy. K.K.

A87-19235
LOGISTICS/ENGINEERING COMMUNITY COOPERATION - A CASE STUDY
C. LUCHUN, P. H. RENSON (Avco Lycoming Textron, Stratford, CT), J. P. DEMASE, and C. E. LANGSTON, JR. (United Technologies Corp., Pratt and Whitney, West Palm Beach, FL) IN: American Helicopter Society, Annual Forum, 42nd, Washington, DC, June 2-4, 1986, Proceedings. Volume 1 . Alexandria, VA, American Helicopter Society, 1986, p. 409-412.

With the increased recognition of Life Cycle Cost in today's market place, it has become evident that a new approach to doing business is required. Many companies are teaming together to consolidate their resources in order to provide the best available products. Such is the case for two industry leaders, AVCO Lycoming and Pratt and Whitney, who have teamed to develop the T800-APW-800 engine for the U.S. Army's LHX helicopter. Their innovative approach to incorporating Reliability, Availability, Maintainability/Integrated Logistics Support/Manpower Personnel Integration (RAM/ILS/MANPRINT) characteristics early in the design phase will insure an end product that meets the customer's requirements. Author

A87-21805* Science Applications International Corp., Albuquerque, N. Mex.
OPENING UP TO THE FUTURE IN SPACE WITH NUCLEAR POWER
DAVID BUDEN (Science Applications International Corp., Albuquerque, NM) and JOSEPH ANGELO, JR. (Florida Institute of Technology, Melbourne) IN: Space nuclear power systems 1985; Proceedings of the Second Symposium, Albuquerque, NM, Jan. 14-16, 1985. Volume 3 . Malabar, FL, Orbit Book Co., Inc., 1987, p. 35-41. Research sponsored by the Florida Institute of Technology, NASA, and DOE. refs

The relationship between the exploration of space and the availability of abundant power supplies is discussed. It is proposed that nuclear power will be needed to satisfy the power demands of manufacturing facilities in LEO, and power demands for the year 2000 are projected to be 300 KW(e). The capabilities and development of the Space Station are described; the use of nuclear power for the Station and various reactor location configurations are studied. The power requirements that will be necessary for the development of lunar resource bases and the exploration of Mars and other planets are considered; the advantages of nuclear power are examined. I.F.

A87-25450*# Boeing Aerospace Co., Seattle, Wash.
SPACE STATION - IMPLICATIONS FOR SPACE MANUFACTURING
D. L. TINGEY, H. J. WILLENBERG (Boeing Aerospace Co., Seattle, WA), and H. L. ATKINS (NASA, Marshall Space Flight Center, Huntsville, AL) Pasha Publications, Conference on Space Station: Gateway to Space Manufacturing, Orlando, FL, Nov. 7, 8, 1985, Paper. 17 p.
(Contract NAS8-36122)

Space-based materials processing R&D is examined. It is proposed that the Space Station's Microgravity and Materials Processing Facility will be utilized by academic, government, and commercial customers. Users requirements for materials processing in space are discussed. Consideration is given to the time allocation of the facility, charges to users, and the property rights of the users. I.F.

A87-27606#
A MODEL FOR ENVELOPING SPACE STATION LOGISTICS REQUIREMENTS
K. M. SEISER and R. E. GIUNTINI (Wyle Laboratories, Huntsville, AL) IN: Space Logistics Symposium, 1st, Huntsville, AL, Mar. 24-26, 1987, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1987, p. 12-20.
(AIAA PAPER 87-0659)

The methods used and results obtained from a logistics analysis of the requirements for the NASA Materials and Technology Laboratory (MTL) module of the Space Station are summarized. The MTL will have facilities for basic and applied research in processing fluids, biological, electronic, chemical, glass, ceramic, and metallic materials and combustion science. The rack-mounted equipment will have standardized interfaces to permit changeouts as desired to accommodate new studies. Quantitative techniques used in logistics analysis to identify the traffic procedures and facilities necessary to maintain flight-ready hardware, hardware in-orbit, and groundside equipment deintegration operations that would maximize MTL utilization are discussed. Methods used to include consideration of crew utilization and the required consumables to ensure that all payloads would receive adequate runtimes are also described. M.S.K.

A87-27607#
WHEN IS LOGISTIC DATA REALLY INTEGRATED OR HOW TO AVOID THE 'TOWER OF BABEL' SYNDROME?
STANFORD E. HOFFMAN (McDonnell Douglas Astronautics Co., Rockville, MD) IN: Space Logistics Symposium, 1st, Huntsville, AL, Mar. 24-26, 1987, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1987, p. 21-26.
(AIAA PAPER 87-0661)

The Space Station will be a long-duration mission, which presents maintenance problems that must be considered in logistics analysis during design. The distribution of project work among four main U.S. contractors and foreign contractors, all coordinated by NASA, will necessitate an automated data system that can be equally accessed by all participants. The data management functions, growth accommondation techniques, security considerations, and compatibility requirements of the data system, which will be routed through NASA links, are explored. NASA must set standards for displays, languages and data element representations. MIL-STD-1388-2A is recommended as a guideline in order to obtain a disciplined structure for logistics data in the data system. M.S.K.

A87-27608*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
THE CHALLENGE OF LOGISTICS FACILITIES DEVELOPMENT
JAMES R. DAVIS (NASA, Kennedy Space Center, Cocoa Beach, FL) IN: Space Logistics Symposium, 1st, Huntsville, AL, Mar. 24-26, 1987, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1987, p. 27-32.
(AIAA PAPER 87-0664)

The paper discusses the experiences of a group of engineers and logisticians at John F. Kennedy Space center in the design, construction and activation of a consolidated logistics facility for support of Space Transportation System ground operations and maintenance. The planning, methodology and processes are covered, with emphasis placed on unique aspects and lessons learned. The project utilized a progressive design, baseline and build concept for each phase of construction, with the Government exercising funding and configuration oversight. Author

A87-27609#
THE ROLE OF INVENTORY MANAGEMENT IN SATELLITE SERVICING
KENNETH E. SHEPARD (Lockheed Missiles and Space Co., Inc., Huntsville, AL) IN: Space Logistics Symposium, 1st, Huntsville, AL, Mar. 24-26, 1987, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1987, p. 33-35.
(AIAA PAPER 87-0667)

The Inventory Management System (IMS) developed for aiding the program manager in planning and decision-making for on-orbit maintenance of the Hubble Space Telescope (HST) is described. The HST will have many custom components, a factor not encountered in logistics analysis of the support requirements of mass-production items on earth. The IMS, when fully configured, will have a database on the status and location of all spare equipment for the HST, will consider the changeout intervals, the costs of each item, and refurshment lead times, and will retain a history of repair, refurbishment and storage facilities for predictive purposes. The components list will cover 51,000 items from over 100 contractors. Definition of the database during development of the HST permitted parts tracking and establishment of the projected maintenance schedules, lead/turnaround times, and identification of critical spares. M.S.K.

A87-29456#
TEST AND VERIFICATION IMPACT ON COMMERCIAL SPACE STATION OPERATIONS
WILLIAM A. GOOD and LEWIS O. SHROYER (Rockwell International Corp., Pittsburgh, PA) IN: Aerospace Testing Seminar, 9th, Los Angeles, CA, Oct. 15-17, 1985, Proceedings . Mount Prospect, IL, Institute of Environmental Sciences, 1986, p. 125-130.

Test and verification procedures for the Space Station operations are discussed. The relation between the design, operations, and software for the Space Station is examined. The roles of design, operations, and software engineers in creating successful commercial Space Station operations are described. I.F.

A87-30918
NEW COMMERCIAL AIRCRAFT PROMISE EFFICIENCY
T. A. HEPPENHEIMER High Technology (ISSN 0277-2981), vol. 7, Feb. 1987, p. 23-27.

Designs for the next generation of transport aircraft are being guided by costs to the purchaser. The various configurations of the propfan, the contrafan, and ducted and unducted turbofans that will be implemented to enhance fuel efficiency are described. Al-Li alloys and composite structures will lower the weight of the new aircraft, which will in nominal operating conditions be flown by flight management computers. Aerodynamic efficiency will be improved with supercritical wings and perforated wings, the latter ensuring continuous laminar flow. Both the propfan and perforated, laminar flow concepts were developed to a state of industrial readiness by NASA efforts. Finally, design concepts which may be used in a next-generation SST are outlined. M.S.K.

A87-35276
BASTART 85 - BONDED AIRCRAFT STRUCTURES, TECHNICAL APPLICATION AND REPAIR TECHNIQUES; PROCEEDINGS OF THE WORKSHOP, BREMEN, WEST GERMANY, JAN. 22-24, 1985
W. BROCKMANN, (ED.) and K. WOLITZ, (ED.) (Fraunhofer-Institut fuer angewandte Materialforschung, Bremen, West Germany) Workshop sponsored by the Deutsche Lufthansa AG and Fraunhofer-Institut fuer angewandte Materialforschung. Bremen, West Germany, Fraunhofer-Institut fuer angewandte Materialforschung, 1985, 322 p. For individual items see A87-35277 to A87-35281.

The present conference on state-of-the-art aircraft primary structure-bonding techniques gives attention to failure characteristics typical of bonded structures, representative bonded structure design features and applications, the projection of design trends in bonded metallic and composite aircraft structural

elements, practical aspects of composite airframe temporary and permanent repair, the repair of primary and secondary structure joints after destruction, and the use of hot paste adhesives in the repair of metal/metal, metal/honeycomb, and composite/honeycomb components. Also discussed are experience with DC-9-80 advanced composites' paint-removal problems, development trends in composite structures for airliners, composite structural design practices in Airbus aircraft, and Lufthansa requirements for future metal and carbon fiber-reinforced bonded structural components. O.C.

A87-35282
COMPUTERIZED AEROSPACE MATERIALS DATA; PROCEEDINGS OF THE WORKSHOP ON COMPUTERIZED PROPERTY MATERIALS AND DESIGN DATA FOR THE AEROSPACE INDUSTRY, EL SEGUNDO, CA, JUNE 23-25, 1986
JACK H. WESTBROOK, ED. (Sci-Tech Knowledge Systems, Scotia, NY) and LOUIS R. MCCREIGHT, ED. (Aerospace Corp., El Segundo, CA) Workshop sponsored by the Aerospace Corp., Strategic Defense Initiative Organization, AIAA, et al. New York, American Institute of Aeronautics and Astronautics, Inc., 1987, 213 p. For individual items see A87-35283 to A87-35285.

Recommendations and guidelines are presented for the development of The National Materials Property Data Network. The underlying motivations for extablishing the Network are delineated, particularly its necessity for maintaining the competitiveness of U.S. industries. Providing on-line access to published technical documentation and research data, the Network subject matter will cover the physical, mechanical, corrosion and chemical properties of materials from indigenous and worldwise sources. The coverage will eventually extend to the optical and electrical properties of materials, along with access to hardcopy information. Information on metals, composites, polymers, structural materials for microapplications, ceramics and adhesives is to be available. Plans for the access procedures and the use interface are explored. Consideration is also given to applying CAD capabilities for integrated life-cycle planning during the design phase. M.S.K.

A87-38751* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
CONCEPTUAL PLANNING FOR SPACE STATION LIFE SCIENCES HUMAN RESEARCH PROJECT
GARY R. PRIMEAUX (NASA, Johnson Space Center, Houston, TX), LADONNA J. MILLER, and ROGER B. MICHAUD (GE Management and Technical Services Co., Houston, TX) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 531-537. refs
(SAE PAPER 860969)

The Life Sciences Research Facility dedicated laboratory is currently undergoing system definition within the NASA Space Station program. Attention is presently given to the Humam Research Project portion of the Facility, in view of representative experimentation requirement scenarios and with the intention of accommodating the Facility within the Initial Operational Capability configuration of the Space Station. Such basic engineering questions as orbital and ground logistics operations and hardware maintenance/servicing requirements are addressed. Biospherics, calcium homeostasis, endocrinology, exercise physiology, hematology, immunology, muscle physiology, neurosciences, radiation effects, and reproduction and development, are among the fields of inquiry encompassed by the Facility. O.C.

A87-38756* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LIFE SCIENCE RESEARCH FACILITY MATERIALS MANAGEMENT REQUIREMENTS AND CONCEPTS
CATHERINE C. JOHNSON (NASA, Ames Research Center, Moffett Field, CA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 579-585.
(SAE PAPER 860974)

The Advanced Programs Office at NASA Ames Research Center has defined hypothetical experiments for a 90-day mission on Space Station to allow analysis of the materials necessary to conduct the experiments and to assess the impact on waste processing of recyclable materials and storage requirements of samples to be returned to earth for analysis as well as of nonrecyclable materials. The materials include the specimens themselves, the food, water, and gases necessary to maintain them, the expendables necessary to conduct the experiments, and the metabolic products of the specimens. This study defines the volumes, flow rates, and states of these materials. Process concepts for materials handling will include a cage cleaner, trash compactor, biological stabilizer, and various recycling devices. Author

A87-40358
AN OPERATIONS MANAGEMENT SYSTEM FOR THE SPACE STATION
TERRY R. SAVAGE (TRW, Inc., Redondo Beach, CA) IN: EASCON '86; Proceedings of the Nineteenth Annual Electronics and Aerospace Systems Conference, Washington, DC, Sept. 8-10, 1986 . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 60-64. refs

A description is provided of an Operations Management System (OMS) for the planned NASA Space Station. The OMS would be distributed both in space and on the ground, and provide a transparent interface to the communications and data processing facilities of the Space Station Program. The allocation of OMS responsibilities has, in the most current Space Station design, been fragmented among the Communications and Tracking Subsystem (CTS), the Data Management System (DMS), and a redefined OMS. In this current view, OMS is less of a participant in the real-time processing, and more an overseer of the health and management of the Space Station operations. Author

A87-40385#
ESTABLISHMENT OF AN ADVANCED COMPOSITE MATERIALS DESIGN CAPABILITY - A CASE FOR COOPERATION?
STEPHEN R. HALL (National Aeronautical Establishment, Ottawa, Canada) and LEONARD K. JOHN (De Havilland Aircraft of Canada, Ltd., Downsview) (CASI, Canadian Symposium on Structures and Materials, 3rd, Ottawa, Canada, June 16-18, 1986) Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 32, Sept. 1986, p. 230-239. refs

The development of a Canadian national data bank for the characterization of basic advanced composite materials data is proposed. The materials characterization program is aimed at defining the physical properties of a material so that an engineer can produce cost-effective hardware that complies with specified structural integrity requirements. The costs and benefits of a national data bank for characterization of materials are discussed. Consideration is given to selecting materials for the data bank; defining material processing and quality control techniques; initial acceptance and storage requirements; manufacturing procedures and inspection; the manufacture and design of test specimens; the testing of specimens; and methods for obtaining design allowables. The management of the data bank, it structure, and the membership criteria are examined. I.F.

A87-41058
RELIABILITY-CENTERED MAINTENANCE
DOUGLAS C. BRAUER (Reliability Technology Associates, Orland Park, IL) and GREG D. BRAUER (Fireman's Fund Insurance Co., Louisville, KY) IEEE Transactions on Reliability (ISSN 0018-9529), vol. R-36, April 1987, p. 17-24. refs

The steps involved in the reliability-centered maintenance engineering process, for the development of optimum maintenance plans which specify requirements and tasks to be performed in achieving, restoring, or maintaining the operational capability of a system, are discussed. A decision logic is applied in the systematic analysis of failure mode, rate, and criticality data to determine the most effective maintenance requirements for maintenance-important items. The process enables the reduction of the scheduled maintenance burden and support costs while sustaining the necessary readiness state. R.R.

A87-43468#
STANDARDIZATION AND LOGISTIC SUPPORT COST EFFECTIVENESS OF ADVANCED AVIONICS SYSTEMS
V. BUONTEMPO (Selenia S.p.A., Pomezia, Italy) DGLR, European Rotorcraft Forum, 12th, Garmisch-Partenkirchen, West Germany, Sept. 22-25, 1986, Paper. 17 p. refs

Modular standardization which has already been adopted within avionic systems can also be used to optimize the logistic support in terms of performance (such as operative availability, maintainability, system reliability, and testing) and costs (purchasing, maintenance, spare parts, technical documentation, training, and ground support equipment). After a short description of the status of technological integration, hardware, and software standardization available to date on avionic systems, a demonstration of the effectiveness of the new maintenance philosophy and concepts (elimination of the second maintenance level) is given. The results derived can be extended to naval and ground defense systems. Author

A87-44745
MATERIALS FOR STRUCTURES OF THE FUTURE
G. B. EVANS (British Aerospace, PLC, Hatfield, England) IN: Materials in aerospace; Proceedings of the First International Conference, London, England, Apr. 2-4, 1986. Volume 2 . London, Royal Aeronautical Society, 1986, p. 303-347. refs

The present evaluation of aircraft structural material development requirements and possibilities gives attention to the complex and consequential ways in which material property advantages, material costs, and aircraft operation fuel costs, interact under pressures exerted by manufacturing costs, politics and the development time horizon for new aircraft designs. The factors of environmental corrosion and protective measures, galvanic corrosion protection, sealants for fuel tanks, adhesively bonded aircraft structures, residual manufacturing stresses, and novel hydraulic systems are also discussed. O.C.

A87-44749
COMPOSITE MATERIALS AND THE CHALLENGE OF BUSINESS RENEWAL
H. J. SEIGEL and R. J. JUERGENS (McDonnell Aircraft Co., St. Louis, MO) IN: Materials in aerospace; Proceedings of the First International Conference, London, England, Apr. 2-4, 1986. Volume 2 . London, Royal Aeronautical Society, 1986, p. 424-439.

A general characterization is made of the opportunities for expansion in composite materials-related industries, and of the managerial and human resources factors that can be marshalled for maximization of that growth. Attention is also given to factors of quality control and comparative productivity. The considerations suggested to be central to the strategic management of the composites industry encompass factory automation, computer-aided curing, improved processing science, and more sophisticated resin characterization. O.C.

A87-44860
WEAVING - ADVANCED COMPOSITE MATERIALS
MARK WILLIAM EDWARDS (Textile Technologies, Inc., Hatboro, PA) Aerospace Engineering (ISSN 0736-2536), vol. 7, June 1987, p. 33-35.

Characteristics of the main types of advanced composite material woven fabrics are discussed, and appropriate applications are considered. Advantages of woven fabrics include improved strength and modulus, fewer problems in lay-up, and improved compatibility with resins. Problems are discussed, including the increased susceptibility to damage as fiber modulus increases and difficulties in the generation of complex shapes. Characteristics of triaxial weaving, a variation of two-dimensional weaving, include uniformity in strength and high resistance to burst, tear, ravel, and shear. Three-dimensional fabrication techniques reinforce composite materials in three mutually orthogonal directions to improve shear strength and rigidity, and applications include carbon-carbon rocket nozzles and quartz/quartz antenna windows. R.R.

A87-51176*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
UP CLOSE - MATERIALS DIVISION OF NASA-LEWIS RESEARCH CENTER
PHILLIP ABEL (NASA, Lewis Research Center, Cleveland, OH) MRS Bulletin (ISSN 0883-7694), vol. 12, Feb. 16-Mar. 16, 1987, p. 85-87.

The eight branches of the Materials Division of NASA-Lewis Research Center are described. The design and capabilities of the Microgravity Materials Science Laboratory are discussed. Consideration is given to the objectives of the ceramic branch, the advanced metallic branch, the metal science branch, and the polymer branch. Also discussed are the research and development efforts of the surface science branch, the environmental durability branch, and the analytic science branch. I.F.

A87-51729
COMPOSITES '86: RECENT ADVANCES IN JAPAN AND THE UNITED STATES; PROCEEDINGS OF THE THIRD JAPAN-U.S. CONFERENCE ON COMPOSITE MATERIALS, SCIENCE UNIVERSITY OF TOKYO, JAPAN, JUNE 23-25, 1986
KOZO KAWATA, ED., SOKICHI UMEKAWA, ED. (Tokyo, Science University, Japan), and AKIRA KOBAYASHI, ED. (Tokyo, University, Japan) Conference sponsored by the Japan Society for Composite Materials and Commemorative Association for the Japan World Exposition. Tokyo, Japan Society for Composite Materials, 1986, 908 p. For individual items see A87-51730 to A87-51807.

The present conference considers topics in the fields of composite reinforcement fibers and fabrics, composite matrix systems, impact and stress waves in composite solids, composite fatigue behavior, composite plate vibration, composite mechanical properties and stress analysis, and composite damage and fracture behavior. Also discussed are laminates and their joints, flexible composite systems, the compression/shear behavior of composites, ceramic-matrix composites, metal-matrix composites, composite fabrication methods, composites testing methods, composite materials design methods, fiber/matrix interfacial phenomena, metal-matrix composite interfaces, environmental effects on composites, and composite fabrication equipment design. O.C.

N87-21750# National Bureau of Standards, Gaithersburg, Md.
MATERIALS INFORMATION FOR SCIENCE AND TECHNOLOGY (MIST): PROJECT OVERVIEW Final Report
W. GRATTIDGE, J. WESTBROOK, J. MCCARTHY, C. NORTHRUP, and J. RUMBLE Nov. 1986 132 p Prepared in cooperation with Sci-Tech Knowledge Systems, Inc., Scotia, N.Y., California Univ., Berkeley, Lawrence Berkeley Lab. and Sandia National Labs., Albuquerque, N. Mex.
(PB87-136677; NBS/SP-726; LC-86-600590) Avail: NTIS HC A07/MF A01; also available SOD HC $8.00 as 003-003-02780-4 CSCL 05B

The report documents the initial phases of the MIST database, which is a demonstration project jointly supported by the Department of Energy and the National Bureau of Standards. The purpose of the Materials Information for Science and Technology (MIST) is to demonstrate the power and utility of computer access to materials property data. The initial goals include: to exercise the concept of a computer network of materials databases and to build a demonstration of such a system in a way as to be suitable for use as the core of operational systems in the future. Phases 1 and 2 are described in detail. In addition, a discussion is given of the expected usage of the databases. GRA

N87-23177# University of Southern California, Redondo Beach. Behavioral Technology Labs.
RESEARCH ON COMPUTER AIDED DESIGN FOR MAINTAINABILITY Technical Report, Jun. 1980 - Oct. 1986
DOUGLAS M. TOWNE and MARK C. JOHNSON 28 Feb. 1987 69 p
(Contract N00014-80-C-0493; RF5-7525)
(AD-A178460; TR-109-ONR) Avail: NTIS HC A04/MF A01 CSCL 09B

The objective of this research was to investigate methods for measuring and predicting equipment maintainability as a consequence of internal structure and the design of the man-machine interface. A computer-based technique has been developed for projecting maintenance workload which is sensitive to design characteristics such as selection for test points and from panel indicators, modularization, internal system architecture and circuitry, and physical packaging of the hardware. The report summarizes the operation of the performance model which generates projected diagnostic sequences for sample failures; it presents a complete example of a maintainability analysis of a system; and it discusses the current application of the technique within an intelligent tutoring system. GRA

N87-25871# Office of Management and Budget, Washington, D.C. Subcommittee on Statistical Uses of Microcomputers in Federal Agencies.
WORKSHOP ON STATISTICAL USES OF MICROCOMPUTERS IN FEDERAL AGENCIES
1 Apr. 1987 104 p Proceedings of Workshop held in Washington, D.C., 24 Apr. 1985
(PB87-166393; STATISTICAL-POLICY-WP-14) Avail: NTIS HC A06/MF A01 CSCL 05A

The Subcommittee on Statistical Uses of Microcomputers in Federal Agencies organized a one-day workshop held on April 24, 1985. The working paper is based on the workshop and discusses four topics: planning to buy and use microcomputers for statistical purposes; electronic data dissemination; applications of microcomputers; and expert systems. The report is intended to provide helpful guidance to Federal agencies in purchasing and using microcomputers for statistical purposes. GRA

09

RELIABILITY AND QUALITY CONTROL

Includes Fault Tolerance, Failure and Error Analysis, Reliability Engineering, Quality Assurance, Wear, Safety Management and Safety, Standards and Measurement, Tests and Testing Inspections, Specifications, Performance Tests, Certification.

A87-10545
SAFE ACCESS TO PRESSURISED HABITABLE SPACES
O. P. HARWOOD British Interplanetary Society, Journal (Space Technology) (ISSN 0007-084X), vol. 39, Aug. 1986, p. 353-356.

Several design approaches are discussed that would allow safe human transfer between space vehicles and modules of the Space Station (SS). Airlines have substantial experience in protecting personnel in pressurized compartments similar to those which will be implemented on the SS. For example, it is known that round doors leak the least on the ends of cylindrical compartments, and that doors on the sides of cylinders always leak. It is recommended that equipment that must pass through airlocks be designed to fit through safe airlocks, rather than increasing the size of airlocks to accommodate larger equipment such as the MMU. Consideration is given to the methods of interconnecting modules to ensure gradual degradation instead of failure, and to selecting doors which do not impede passage through an airlock. A simplified design of a two-piece, integrally machined door with bayonet locking attachments similar to those on camera lenses is proposed as a candidate SS component. M.S.K.

A87-12653
RESEARCH AND DEVELOPMENT OF AUTOMATION OF NONDESTRUCTIVE TESTING METHODS
G. F. J. VAN BOCHOVE and P. A. A. M. SOMERS (Fokker, Schiphol, Netherlands) IN: Progress in advanced materials and processes: Durability, reliability and quality control; Proceedings of the Sixth International European SAMPE Conference, Scheveningen, Netherlands, May 28-30, 1985 . Amsterdam and New York, Elsevier, 1985, p. 29-39. refs

The use of computer algorithms to improve NDT methods is described. The technical, economic, and social aspects of automatic NDT methods are discussed. The use of a robotic system to automate the Fokker Bondtester, which is applied to the inspection of cohersion strength of bonded joints, and the operation of the robotic system are examined. The development of procedures for automatic evaluation of ultrasonic C-scan and holographic data is studied. I.F.

A87-17959#
THE FUTURE OF THE NATIONAL AIRSPACE SYSTEM
A. G. MORGAN, JR. (Delta Air Lines, Inc., Atlanta, GA) AIAA, AHS, and ASEE, Aircraft Systems, Design and Technology Meeting, Dayton, OH, Oct. 20-22, 1986. 6 p.
(AIAA PAPER 86-2743)

Issues related to the improvement of the ATC system are examined. The need for a new method of centralized flow control of traffic, and the disadvantages of mandatory capacity constraints are considered. The role of the FAA in the development of an efficient airspace system with regard to user's requirements is discussed. I.F.

A87-18006
PRODUCT DESIGN ASSURANCE - CHALLENGES AND TRENDS. I
H. B. CHENOWETH (Westinghouse Electric Corp., Baltimore, MD) Society of Environmental Engineers, Journal (ISSN 0374-356X), vol. 25-1, March 1986, p. 3-9. refs

Advances in product design assurance are examined. Product design assurance is discussed in terms of a systems science and an engineering discipline. The development of specifications, standards, and handbooks related to the environmental and reliability methods is discussed. Design concepts such as

specification goal analysis, allocations, prediction, and thermal optimization at the electronic device level are considered. I.F.

A87-18007
PRODUCT DESIGN ASSURANCE - CHALLENGES AND TRENDS. II
H. B. CHENOWETH (Westinghouse Electric Corp., Baltimore, MD) Society of Environmental Engineers, Journal (ISSN 0374-356X), vol. 25-2, June 1986, p. 3-12. refs

Trends in development testing and screening are considered. Development testing is discussed in terms of characterization and reliability testing. The techniques of part and assembly stress screening are described. The effect of characterization on screening is examined. Examples of part and assembly stress screening are presented. I.F.

A87-18010
PRODUCT DESIGN ASSURANCE - CHALLENGES AND TRENDS. III
H. B. CHENOWETH (Westinghouse Electric Corp., Baltimore, MD) Society of Environmental Engineers, Journal (ISSN 0374-356X), vol. 25-3, Sept. 1986, p. 7-11. refs

The use of dynamic programming and the utility theory to obtain an optimum production sequence for screening is described. The application of the evolutionary operation model to the refinement of the production sequences derived by dynamic programming and the utility theory is examined. The effect of screening on reliability growth is analyzed. Future developments which may affect the international production design assurance engineering and technology community are discussed. I.F.

A87-19069
AVIONICS MAINTENANCE 2010
D. DOWLING and T. L. RUPINSKI (ARINC Research Corp., Annapolis, MD) IEEE Journal on Selected Areas in Communications (ISSN 0733-8716), vol. SAC-4, Oct. 1986, p. 1090-1096.

This paper postulates an avionics maintenance concept for the year 2010. The concept recognizes the change that is occurring in new systems toward internal fault isolation using built-in test. Currently, fault isolation data are held in the failed system or within the aircraft computer for subsequent analysis by maintenance personnel. Under the Maintenance 2010 concept, fault data would be analyzed as soon as possible during a mission to identify replacement components needed. A data link from the aircraft to a ground maintenance support system is proposed to permit further diagnosis of faults and to expedite preparation for immediate corrective maintenance action on the flight line when the aircraft returns. The concept is designed to eliminate aircraft down time while awaiting maintenance and thereby improve operational readiness. Author

A87-24174
A SYSTEMS APPROACH TO SAFE AIRSPACE OPERATIONS
RICHARD CLARKE ICAO Bulletin, vol. 41, Sept. 1986, p. 33-35.

An effective way of linking airspace system planning to the achievement of the requisite level of operational safety is through the application of system safety management and engineering to ensure maximum integration and minimum system oversights. System safety design has a life-cycle orientation that follows a program from concept development, through operation, to eventual disposal. The effectiveness of man/machine interfaces is ensured, and a hazard-identification process is implemented in place of the more conventional failure-identification orientation. O.C.

A87-25823
NDT OF JET ENGINES - AN INDUSTRY SURVEY. I
Materials Evaluation (ISSN 0025-5327), vol. 44, Dec. 1986, p. 1477, 1478, 1480-1482, 1484, 1485.

Various NDT techniques for inspecting jet engines are examined. The use of borescopes to visually inspect for apparent damage to internal structures of the engines, in particular combustion chamber liners, is discussed. Flexible fiber optics, guide tubes, and imaging have been employed to improve borescopes. Consideration is given to the application of liquid penetration testing, IR testing, leak testing, holography, flow measurements, vibration testing, material characterization, and acoustic microscopy to NDT of jet engines. I.F.

A87-27602
COLLISION RISK IN THE WIDE OPEN SPACES
W. G. SCULL (British Gliding Association, England) and W. A. O'N. WAUGH (Toronto, University, Canada) Aerospace (UK) (ISSN 0305-0831), vol. 13, Dec. 1986, p. 15-17. refs

The application of scientific risk-assessment and risk-management techniques to aviation is discussed, using the UK open Flight Information Region (FIR) as an example. Consideration is given to the problems of perceived risk and biases in estimating the risk of death or severe injury; the general difficulty of obtaining accurate data; assessment of FIR collision risks on the basis of government traffic censuses, airmiss reports, and the frequency with which pilots or carriers choose FIR rather than airway routes; and management of FIR risks by improving radar services and/or extending control zones. The need for more extensive data and for consistent application of risk-management techniques is indicated. T.K.

A87-29441
AEROSPACE TESTING SEMINAR, 9TH, LOS ANGELES, CA, OCT. 15-17, 1985, PROCEEDINGS
Seminar sponsored by the Institute of Environmental Sciences and Aerospace Corp. Mount Prospect, IL, Institute of Environmental Sciences, 1986, 268 p. For individual items see A87-29442 to A87-29471.

Papers are presented on the qualification/acceptance program for the Hubble Space Telescope, launch vehicle platform and high-energy upper stage acceptance testing, the integrated spacecraft automated test system, characteristics of electromagnetic interference generated by arc discharging, and strain gage selection and bonding techniques for application in a cryogenic-pyrotechnic environment. Topics discussed include a design verification system for advanced aerospace engines, a Space Station propulsion system test bed, test and verification impact on commercial Space Station operations, cost effective management of space venture risks, and automated microwave testing of spacecraft. Consideration is given to vibration testing of large spacecraft; transfer-orbit-stage off-line processing; utilization, testing, and maintenance of multimission hardware; payload vibroacoustics for Shuttle peculiar environments; and automatic, integrated facility record systems for Shuttle processing at Vandenberg AFB. I.F.

A87-29445#
MANNED SPACE VEHICLE TESTING PHILOSOPHY CHANGES
RAY WEAVER (Martin Marietta Corp., Bethesda, MD) IN: Aerospace Testing Seminar, 9th, Los Angeles, CA, Oct. 15-17, 1985, Proceedings . Mount Prospect, IL, Institute of Environmental Sciences, 1986, p. 31-34.

The development of an optimum test strategy for evaluating space vehicles is examined. It is necessary to have adequate testing of assemblies and systems in order to insure a successful space program. Consideration is given to the full-up testing initiated during the Apollo program; the remove, replace, and return-to-the-vendor scheme for eliminating redundant testing and reducing costs; and space vehicle testing aimed at insuring a quality product in an adequate amount of time and at reasonable costs. The objectives of a test plan aimed at defect prevention are discussed. I.F.

A87-31096*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AUTOMATED MODEL GENERATION FOR RELIABILITY ANALYSIS PROGRAMS
SALLY C. JOHNSON and RICKY W. BUTLER (NASA, Langley Research Center, Hampton, VA) International Symposium on Fault-Tolerant Computing, 17th, Portland, OR, June 17-19, 1987, Paper. 16 p. refs

Semi-Markov models (a generalization of Markov models) can be used to calculate the reliability of virtually any fault-tolerant system. However, the process of delineating all of the states and transitions in the model of a complex system can be devastatingly tedious and error-prone. The ASSIST program allows the user to describe the semi-Markov model in a high-level language. Instead of specifying the individual states of the model, the user specifies the rules governing the behavior of the system, and these are used by ASSIST to automatically generate the model. A small number of statements in the abstract language can be used to describe a very large, complex model. Because no assumptions are made about the system being modeled, the ASSIST program can be used to generate models describing the behavior of any type of system. The ASSIST program and its input language are described and illustrated by examples. Author

A87-31107*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SCIENCE AND TECHNOLOGY ISSUES IN SPACECRAFT FIRE SAFETY
ROBERT FRIEDMAN and KURT R. SACKSTEDER (NASA, Lewis Research Center, Cleveland, OH) AIAA, Aerospace Sciences Meeting, 25th, Reno, NV, Jan. 12-15, 1987. 29 p. Previously announced in STAR as N87-16012. refs
(AIAA PAPER 87-0467)

The space station, a permanently-inhabited orbiting laboratory, places new demands on spacecraft fire safety. Long-duration missions may call for more-constrained fire controls, but the accessibility of the space station to a variety of users may call for less-restrictive measures. This paper discusses fire safety issues through a review of the state of the art and a presentation of key findings from a recent NASA Lewis Research Center Workshop. The subjects covered are the fundamental science of low-gravity combustion and the technology advances in fire detection, extinguishment, materials assessment, and atmosphere selection. Key concerns are for the adoption of a fire-safe atmosphere and the substitution for the effective but toxic extinguishant, halon 1301. The fire safety studies and reviews provide several recommendations for further action. One is the expanded research in combustion, sensors, and materials in the low-gravity environment of space. Another is the development of generalized fire-safety standards for spacecraft through cooperative endeavors with aerospace and outside Government and industry sources. Author

A87-33020
MAN/SYSTEM INTEGRATION STANDARDS FOR SPACE SYSTEMS
KEITH H. MILLER (Boeing Aerospace Co., Seattle, WA) IN: Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volume 1 . Santa Monica, CA, Human Factors Society, 1986, p. 358-362.

This paper presents an overview of the Man/System Integrations Standards (MSIS) program. The standards to be developed by this program provide specific information for use in the design of space systems to ensure proper integration of the man/system interface requirements with those of other aerospace disciplines. These man/system interface requirements apply to the launch, reentry, on-orbit, and extraterrestrial space environments. Concise design considerations, design requirements, and design examples are provided. The standards are being developed with broad government and industry collaboration via a Government/Industry Advisory Group (GIAG) that meets four times with the contractor team to critique the standards as they are being developed. The documentation (released in January 1987) will consist of four hardcopy volumes, a videotape, and a relational database. The videotape uses in-space film footage from Gemini, Skylab, and the Shuttle to illustrate specific man/system integration problems (scenes are cross-referenced to the MSIS topics). The relational database provides a means for storing and manipulating the MSIS data. Author

A87-35599
SAFETY ON THE SPACE STATION
MAURA J. MACKOWSKI Space World (ISSN 0038-6332), vol. X-3-279, March 1987, p. 22-24.

Safety features which are either being designed in or considered for the Space Station are discussed briefly. The overall design approach is that of a safe haven, where all modules are independent units to which crew can retreat. The major hazards are fire, meteor impact, or the internal release of hazard materials. Fire extinguishing equipment that was flown on the Gemini, Apollo and Skylab missions is reviewed for the relevancy to the Space Station. A leading design option is a computer-controlled monitoring system that could flood a module with Halon 1301, backed up by portable extinguishers. Several manufacturers are independently pursuing studies of lifeboats for permitting up to seven crewmembers to abandom the Station and parachute to earth in life-threatening emergency. M.S.K.

A87-38780
AN EVALUATION OF OPTIONS TO SATISFY SPACE STATION EVA REQUIREMENTS
JOSEPH J. THOMPSON, KENNETH S. BROSSEL (Boeing Aerospace Co., Seattle, WA), and BRUCE W. WEBBON (SRI International, Menlo Park, CA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 845-861.
(SAE PAPER 861008)

The Space Station mission requirements for initial frequent use of EVA require the modification of the existing Shuttle suit and the Shuttle Extravehicular Mobility Unit (EMU). Options for a Space Station EVA space suit are described and evaluated in light of the Space Station mission human and environmental requirements. The evaluation is made to select the most cost-effective and technologically feasible alternative that meets the requirements. Requirements considered include: (1) the heavy, almost industrial use, of the suit; (2) long operational life; (3) on-orbit maintenance and fit check; (4) high mobility; (5) rapid don/doff; (6) high pressure for zero pre-breath; (7) radiation protection; (8) micrometeoroid/space debris protection; (9) thermal insulation; (10) contamination/decontamination factors; (11) automatic checkout; and (12) low development and recurring costs. Author

A87-45125#
THE AIR FORCE FLIGHT TEST CENTER - NOW AND THE FUTURE
CHARLES E. ADOLPH (USAF, Flight Test Center, Edwards AFB, CA) IN: International Instrumentation Symposium, 32nd, Seattle, WA, May 5-8, 1986, Proceedings . Research Triangle Park, NC, Instrument Society of America, 1986, p. 535-537.

The Air Force Flight Test Center (AFFTC) conducts and supports manned and unmanned aircraft flight tests, development testing of parachutes, operates the Edwards Flight Test Range, the USAF Test Pilot School, and the Utah Test and Training Range. This paper summarizes the evolutionary forces in the technical and management areas which gave impetus to today's methods of operation. Current capabilities and procedures are then described, followed by a discussion of improvements planned to meet the demands of the late 1980's. The largest single challenge facing the military flight test community in the next decade is the efficient evaluation of software-intensive avionics systems. Author

A87-45976
A TIME OF TESTING FOR THE SHUTTLE
SUE BUTLER HANNIFIN Space World (ISSN 0038-6332), vol. X-6-282, June 1987, p. 11-15.

Ongoing NASA efforts to redesign the Space Shuttle solid rocket boosters (SRBs) and resume launch operations after the loss of the Challenger are examined critically. Economic and political factors limiting the range of choices open to project managers are stressed; the reasons for delays in the testing program are discussed; and it is argued that the SRB R&D effort may have to be started over if the joint modifications proposed so far should prove to be inadequate. Also included is a brief history of solid propulsion, with a focus on the advantages and disadvantages of solid rocket motors for manned space missions. T.K.

A87-46226#
INTEGRATION OF ENGINE/AIRCRAFT CONTROL - 'HOW FAR IS IT SENSIBLE TO GO'
V. A. FISHER (Rolls Royce, PLC, Bristol, England) IN: International Symposium on Air Breathing Engines, 8th, Cincinnati, OH, June 14-19, 1987, Proceedings . New York, American Institute of Aeronautics and Astronautics, 1987, p. 453-458. Research supported by the Ministry of Defence (Procurement Executive).

A development history is presented for the propulsion control systems of such high performance aircraft as Concorde, at the outset, the 1970s Tornado, and most recently the European Fighter Aircraft full authority digital engine controls. Engine control systems modulate fuel flow for optimum performance; integration aspects of the operation of single and twin engine aircraft are discussed with a view to practical boundaries encountered in hardware that must be marketable over a 10-20 year period. Integration methods based on communications rather than physical joining are recommended. O.C.

A87-46727
CULPRITS CAUSING AVIONIC EQUIPMENT FAILURES
KAM L. WONG, IRVING QUART (Kambea Industries, Inc., Manhattan Beach, CA), JAMES M. KALLIS (Hughes Aircraft Co., El Segundo, CA), and ALAN H. BURKHARD (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN: 1987 Annual Reliability and Maintainability Symposium, Philadelphia, PA, Jan. 27-29, 1987, Proceedings . New York, Institute of Electrical and Electronics Engineers, Inc., 1987, p. 416-421.

An examination of industrial and military failure data is performed to determine the major locations and types of defects causing avionics field failures. Field failures were found to occur primarily in devices containing semiconductors, with discrete capacitors and discrete resistors being less frequent locations of failures. Connectors, relays, filters, and magnetic devices were found to be insignificant contributors to failures, while solder joints and printed circuit boards are believed to have a significant number of failures. More than a dozen types of defects, each contributing to a small fraction of the failures, have been identified. R.R.

A87-46728
RELIABILITY, 'BETTER THAN THE BEST'
JOHN SIECZKOS and WILLIAM G. KINDIG (General Electric Co., Binghamton, NY) IN: 1987 Annual Reliability and Maintainability Symposium, Philadelphia, PA, Jan. 27-29, 1987, Proceedings . New York, Institute of Electrical and Electronics Engineers, Inc., 1987, p. 428-432.

The design, testing, and production of commercial and military engine controls are addressed, and the successful transfer of technology and program structure/discipline from the flight control product line to engine controls is reported. Special considerations in the areas of operating environment, operating hours, cycle times, and technology changes from potted modules with hard wiring to printed circuit boards with interconnecting motherboards are discussed. Hardware complexity, including the MIL-HDK-217 predicted analytical failure rate, is also considered. Initial field tests in both the commercial and military user environment demonstrate the high reliability performance of the engine controls. R.R.

A87-46946
PREVENTING COLLISIONS IN ORBIT
NICHOLAS L. JOHNSON (Teledyne Brown Engineering, Huntsville, AL) Space (ISSN 0267-954X), vol. 3, May-June 1987, p. 17-19.

The danger posed by satellite debris orbiting the earth is discussed. Explosions have already contributed significantly to producing such debris, and high-velocity collisions, which are not known to have occurred, individually have the potential of producing much more debris than explosions. The role of orbital plane in reducing or enhancing the chance of collision is addressed, and the need for studying the causes of unexplained rocket explosions is emphasized. C.D.

A87-48063
QUALITY AND ENVIRONMENTAL STANDARDS
H. GOLDBERG (GEC Avionics, Ltd., Borehamwood, England) IN: Cost-effective avionic and weapon systems; Proceedings of the Spring Convention, London, England, May 14, 15, 1986 . London, Royal Aeronautical Society, 1987, p. 12.1-12.12. refs

An institutional development history and operational effectiveness evaluation is presented for quality and environmental standards organizations such as the British Standards Institution, the British Engineering Standards Association, the International Civil Aviation Organization, and the International Electrotechnical Commission. The importance of standards is demonstrated for the case of the quality of an electronic component that can have substantial effects on the life cycle cost of the equipment in which it is employed. Attention is given to the results of the testing of various types of electronic components according to the BS 9000 and MIL-STD-883 standards, other military specs, and commercial standards. O.C.

A87-48603#
LESSONS LEARNED FROM PAST PROGRAMS - AIR TRAFFIC CONTROL
B. N. ETHERIDGE and R. W. PEAK, JR. (Martin Marietta Corp., Air Traffic Control Div., Washington, DC) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 10 p.
(AIAA PAPER 87-2222)

The application of system engineering management to the modernization of large systems, in particular to the National Airspace System (NAS), is examined. The classical approach to system engineering, and the four-level scheme for the design of the NAS are discussed. Consideration is given to system and subsystem requirements, design, and integration, and system verification, deployment, and activation. I.F.

A87-50418*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMULATION EVALUATION OF THE CONTROL SYSTEM COMMAND MONITORING CONCEPT FOR THE NASA V/STOL RESEARCH AIRCRAFT (VSRA)
J. A. SCHROEDER (NASA, Ames Research Center, Moffett Field, CA; U.S. Army, Aviation Research and Technology Activity, E. MORALEZ, and V. K. MERRICK (NASA, Ames Research Center, Moffett Field, CA) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 133-154. refs
(AIAA PAPER 87-2255)

A control-system monitoring concept is described that has the potential of rapidly detecting computer command failures (hardware or software) in fly-by-wire control systems. The concept has been successfully tested on the NASA Vertical/Short Takeoff and Landing Research Aircraft (VSRA) in the Ames Research Center's Vertical Motion Simulator. The test was particularly stringent, since the VSRA is required to operate in a hazardous environment. The fidelity of the aircraft model used in the simulation was verified by flying both the simulated and actual aircraft in a precision hover task using specially designed targets. Author

A87-53811
AUTOMATED MICROWAVE TESTING OF SPACECRAFT
R. W. VORECK (Ford Aerospace and Communications Corp., Palo Alto, CA) IEE Proceedings, Part F - Communications, Radar and Signal Processing (ISSN 0143-7070), vol. 134, pt. F, no. 5, Aug. 1987, p. 510-523.
(Contract INTELSAT-IS-796)

The test measurement requirements and implementation techniques of microwave automatic test equipment (MATE) for the preflight evaluation of the performance of communications subsystems of satellites are discussed. The MATE system is found to be cost-effective, and to have the flexibility to handle spacecraft requirements. In addition to providing high-speed automated testing, data analysis, and display, MATE makes possible rapid reconfiguration and test method restructuring when needed for investigating anomalous performance or for the introduction of special tests. Limitations of the system include the 70 sec processing time for hard copy of graphic displays and the inability to perform multiple tests simultaneously. It is noted that computer-aided measurement helped make the Intelsat V program economically feasible. R.R.

N87-10876*# National Aeronautics and Space Administration, Washington, D.C.
AERONAUTICAL FACILITIES ASSESSMENT
F. E. PENARANDA, comp. Nov. 1985 204 p
(NASA-RP-1146; NAS 1.61:1146) Avail: NTIS HC A10/MF A01 CSCL 14B

A survey of the free world's aeronautical facilities was undertaken and an evaluation made on where the relative strengths and weaknesses exist. Special emphasis is given to NASA's own capabilities and needs. The types of facilities surveyed are: Wind Tunnels; Airbreathing Propulsion Facilities; and Flight Simulators Author

N87-10888# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SPACE SHUTTLE PAYLOAD DESIGN AND DEVELOPMENT
D. C. WADE and D. A. HAMILTON *In* ESA Proceedings of an International Conference on Spacecraft Structures p 11-16 Apr. 1986
Avail: NTIS HC A19/MF A01

The structural design guidelines and requirements for payloads launched on the Space Shuttle are reviewed. Experience with scientific and commercial satellites and experiments is presented. Structural requirements for payloads are divided into the areas of mechanical interfaces, load environments, and materials. The mechanical interfaces include physical sizing allowables, attachment mechanisms, attach point locations, and remote manipulator system requirements. The structural loading environments include preliminary design load factors, random vibration, and acoustics. Coupled-loads analysis requirements and methodology are discussed along with payload math model characteristics. Frequency restrictions to avoid flight control interaction are defined. Requirements and options for strength certification, math model verification, and materials-related design requirements are discussed. ESA

N87-12909# Committee on Science and Technology (U.S. House).
NASA'S QUALITY ASSURANCE PROGRAM
1986 163 p Hearing before the Subcommittee on Space Science and Applications of the Committee on Science and Technology, 99th Congress, 2d Session, No. 126, 21 May 1986
(GPO-63-142) Avail: Subcommittee on Space Science and Applications

The number of quality assurance personnel have declined dramatically since the Apollo Program. The facts and implications of the decline were examined. A system of checks and balances to accomplish quality control were also discussed. A panel of well-known experts described how an ideal quality assurance program should work. B.G.

N87-12912# Naval Personnel Research and Development Center, San Diego, Calif. Human Factors and Organizational Systems Lab.
QUALITY MANAGEMENT: AN ANNOTATED BIBLIOGRAPHY
M. MONDA, P. J. THRAPP, and E. L. GOLDBERG Jun. 1986 92 p
(AD-A169816; HFOSL-TN-72-86-07) Avail: NTIS HC A05/MF A01 CSCL 05A

As America strives to compete in the international marketplace, many U.S. businesses have adopted a new way of managing and measuring quality and productivity. The quality management methods focus on the systematic measurement and control of work processes. Successful quality management programs are credited with increases in profit, reduction of waste, and improved management-worker relations. This annotated bibliography is oriented toward those persons who are new to or only recently acquainted with the concept of quality management. The main body of journal articles, books, videotapes, and magazines selected from academia and industry focus on the introduction of the concepts, the terminology, and the personalities associated with the quality management movement. Citations include information about the author, date, title, and source, as well as a set of terms that summarize the key concepts of the citation and a brief abstract. Several articles are identified and recommended as an orientation to the field of total quality management. GRA

N87-13583*# National Bureau of Standards, Gaithersburg, Md. Center for Fire Research.
FIRE SAFETY EVALUATION SYSTEM FOR NASA OFFICE/LABORATORY BUILDINGS
H. E. NELSON Nov. 1986 37 p Sponsored by NASA
(NASA-CR-179983; NAS 1.26:179983; NBSIR-86-3404) Avail: NTIS HC A03/MF A01 CSCL 57U

A fire safety evaluation system for office/laboratory buildings is developed. The system is a life safety grading system. The system scores building construction, hazardous areas, vertical openings, sprinklers, detectors, alarms, interior finish, smoke control, exit systems, compartmentation, and emergency preparedness. Author

N87-16012*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SCIENCE AND TECHNOLOGY ISSUES IN SPACECRAFT FIRE SAFETY
ROBERT FRIEDMAN and KURT R. SACKSTEDER Jan. 1987 29 p Presented at the 25th Aerospace Sciences Meeting, Reno, Nev., 12-15 Jan. 1987; sponsored by AIAA
(NASA-TM-88933; E-3349; NAS 1.15:88933; AIAA-87-0467)
Avail: NTIS HC A03/MF A01 CSCL 22B

The space station, a permanently-inhabited orbiting laboratory, places new demands on spacecraft fire safety. Long-duration missions may call for more-constrained fire controls, but the accessibility of the space station to a variety of users may call for less-restrictive measures. This paper discusses fire safety issues through a review of the state of the art and a presentation of key findings from a recent NASA Lewis Research Center Workshop. The subjects covered are the fundamental science of low-gravity combustion and the technology advances in fire detection, extinguishment, materials assessment, and atmosphere selection. Key concerns are for the adoption of a fire-safe atmosphere and the substitution for the effective but toxic extinguishant, halon 1301. The fire safety studies and reviews provide several recommendations for further action. One is the expanded research in combustion, sensors, and materials in the low-gravity environment of space. Another is the development of generalized fire-safety standards for spacecraft through cooperative endeavors with aerospace and outside Government and industry sources. Author

N87-16652*# National Aeronautics and Space Administration, Washington, D.C.
HIGHLIGHTS OF CONTRACTOR INITIATIVES IN QUALITY ENHANCEMENT AND PRODUCTIVITY IMPROVEMENT
Jul. 1986 110 p
(NASA-TM-89266; NAS 1.15:89266; PB87-103750) Avail: NTIS HC A06/MF A01 CSCL 05A

The NASA/Contractor Team efforts are presented as part of NASA's continuing effort to facilitate the sharing of quality and productivity improvement ideas among its contractors. This compilation is not meant to be a comprehensive review of contractor initiative nor does it necessarily express NASA's views. The submissions represent samples from a general survey, and were not edited by NASA. The efforts are examples of quality and productivity programs in private industry, and as such, highlight company efforts in individual areas. Topics range from modernization of equipment, hardware, and technology to management of human resources. Of particular interest are contractor initiatives which deal with measurement and evaluation data pertaining to quality and productivity performance. GRA

N87-16653*# National Aeronautics and Space Administration, Washington, D.C.
SUMMARY OF STRATEGIES FOR PLANNING PRODUCTIVITY IMPROVEMENT AND QUALITY ENHANCEMENT (PIQE)
Apr. 1986 40 p
(NASA-TM-89310; NAS 1.15:89310; PB87-103743) Avail: NTIS HC A03/MF A01 CSCL 05A

The Summary of NASA Strategies for Productivity Improvement and Quality Enhancement respond to NASA's eighth top goal: Establish NASA as a leader in the development and application of advanced technology and management practices which contribute to significant increases in both Agency and national productivity. The Strategies provide the framework for development of the agency-wide Productivity Improvement and Quality Enhancement (PIQE) Plans. GRA

N87-20342*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FIRE SAFETY CONCERNS IN SPACE OPERATIONS
ROBERT FRIEDMAN 1987 13 p Prepared for presentation at the Joint Army-Navy-NASA-Air Force (JANNAF) Safety and Environmental Protection Subcommittee Meeting, Cleveland, Ohio, 4-7 May 1987
(NASA-TM-89848; E-3511; NAS 1.15:89848) Avail: NTIS HC A02/MF A01 CSCL 22A

This paper reviews the state-of-the-art in fire control techniques and identifies important issues for continuing research, technology, and standards. For the future permanent orbiting facility, the space station, fire prevention and control calls for not only more stringent fire safety due to the long-term and complex missions, but also for simplified and flexible safety rules to accommodate the variety of users. Future research must address a better understanding of the microgravity space environment as it influences fire propagation and extinction and the application of the technology of fire detection, extinguishment, and material assessment. Spacecraft fire safety should also consider the adaptation of methods and concepts derived from aircraft and undersea experience. Author

N87-21651# National Bureau of Standards, Gaithersburg, Md. Center for Basic Standards.
TECHNICAL ACTIVITIES 1986, CENTER FOR BASIC STANDARDS
P. L. M. HEYDEMANN Oct. 1986 340 p
(PB87-140315; NBSIR-86/3469) Avail: NTIS HC A15/MF A01 CSCL 20C

The report summarizes the research and technical activities of the Center for Basic Standards during the Fiscal Year 1986. These activities include work in the areas of electricity, temperature and pressure, mass and length, time and frequency, quantum metrology, and quantum physics. GRA

N87-23705# Northrop Corp., Hawthorne, Calif. Aircraft Div.
CERTIFICATION TESTING METHODOLOGY FOR COMPOSITE STRUCTURE. VOLUME 1: DATA ANALYSIS Final Report
R. S. WHITEHEAD, H. P. KAN, R. CORDERO, and E. S. SAETHER Oct. 1986 94 p Prepared in cooperation with Naval Air Development Center, Warminster, Pa. and Federal Aviation Agency, Atlantic City, N.J.
(Contract N62269-84-C-0243)
(NADC-87042-60-VOL-1; DOT/FAA/CT-86/39-VOL-1) Avail: NTIS HC A05/MF A01

This research developed a certification testing methodology for composite structures. The existing composite static strength and fatigue life data are analyzed statistically to determine the influence of test parameters on the scatter of composite data. Guidelines to use the composite data scatter in structural certification are recommended. Various approaches to composite structures certification are analytically evaluated. The approaches evaluated are: scatter factor approach, load enhancement factor approach, ultimate strength approach,and change in spectrum approach. The capability, advantages and disadvantages of each approach to determine the minimum life and/or strength are discussed. Volume 1 contains Data Analysis. Author

N87-23706# Northrop Corp., Hawthorne, Calif. Aircraft Div.
CERTIFICATION TESTING METHODOLOGY FOR COMPOSITE STRUCTURE. VOLUME 2: METHODOLOGY DEVELOPMENT Final Report
R. S. WHITEHEAD, H. P. KAN, R. CORDERO, and E. S. SAETHER Oct. 1986 286 p
(Contract N62269-84-C-0243)
(NADC-87042-60-VOL-2; DOT/FAA/CT-86/39-VOL-2) Avail: NTIS HC A13/MF A01

This research developed a certification testing methodology for composite structures. The existing composite static strength and fatigue life data are analyzed statistically to determine the influence of test parameters on the scatter of composite data. Guidelines to use the composite data scatter in structural certification are recommended. Various approaches to composite structures certification are analytically evaluated. The approaches used are: scatter factor, load enhancement, ultimate strength, and change in spectrum. The capability, advantages and disadvantages of each approach to determine the minimum life and/or strength are discussed. Volume 2 traces Methodology Development.
Author

N87-28753# Quality Assurance Directorate (Materials), London (England). Central Packaging Unit.
VALUE ENGINEERING: A HANDBOOK FOR USE IN PACKAGE DESIGN
Dec. 1985 55 p
(CPU/DR/10-1; BR100951; ETN-87-90261) Avail: NTIS HC A04/MF A01

Value engineering is reviewed, and its use in designing packing is explained. ESA

N87-29468# General Accounting Office, Washington, D. C. Resources, Community and Economic Development Div.
AVIATION SAFETY: PROCEDURES FOR REGISTERING AND CERTIFYING AIR CARRIERS
May 1987 36 p
(PB87-193249; GAO/RCED-87-115FS; B-226786) Avail: NTIS HC A03/MF A01 CSCL 01C

The fact sheet describes the procedures two Dept. of Transportation (DOT) organizations, the Office of the Secretary of Transportation (OST) and the Federal Aviation Administration (FAA), use to register and certify air carriers of the type chartered by the Department of Defense (DOD). To document the procedures OST and FAA use to determine whether an air carrier should be granted these documents, officials were interviewed at OST and FAA headquarters and at FAA's flight standards district office in Seattle, Wash. At these locations, applicable FARS and various DOT, OST, and FAA records were reviewed. Although the registration and certification processes were documented, how well

they were actually being carried out was not evaluated nor was how well OST monitors registration and certifications once they were granted. The report on the FAA's air carrier inspection program addresses how well FAA's inspection program monitors air carriers after they receive FAA operating certificates. GRA

N87-30210*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PROGRAM RISK ANALYSIS HANDBOOK
R. G. BATSON Aug. 1987 85 p
(NASA-TM-100311; NAS 1.15:100311) Avail: NTIS HC A05/MF A01 CSCL 05A

NASA regulations specify that formal risk analysis be performed on a program at each of several milestones. Program risk analysis is discussed as a systems analysis approach, an iterative process (identification, assessment, management), and a collection of techniques. These techniques, which range from extremely simple to complex network-based simulation, are described in this handbook in order to provide both analyst and manager with a guide for selection of the most appropriate technique. All program risk assessment techniques are shown to be based on elicitation and encoding of subjective probability estimates from the various area experts on a program. Techniques to encode the five most common distribution types are given. Then, a total of twelve distinct approaches to risk assessment are given. Steps involved, good and bad points, time involved, and degree of computer support needed are listed. Why risk analysis should be used by all NASA program managers is discussed. Tools available at NASA-MSFC are identified, along with commercially available software. Bibliography (150 entries) and a program risk analysis check-list are provided. Author

10

LEGALITY, LEGISLATION, AND POLICY

Includes Laws and Legality, Insurance and Liability, Patents and Licensing, Legislation and Government, Regulation, Appropriations and Federal Budgets, Local, National, and International Policy.

A87-10504
SPACE LAW - IS IT THE LAST LEGAL FRONTIER?
E. JERICHO and D. G. MCCRACKEN (Strasburger and Price, Dallas, TX) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 51, Summer 1986, p. 791-808. refs

It is found to be highly doubtful whether the evolving jurisprudence associated with man's growing activities in space is the last legal frontier. At present legal dictionaries do not yet define space law. This paper is concerned with such a definition. A review is conducted of the international law aspects already incorporated into the jurisprudence known as space law, taking into account some pertinent and timely international law issues which have arisen and which will undoubtedly have to be addressed. The growing areas of arising private commercial enterprise and legal issues are identified, and the highly volatile subject of space insurance is discussed. It is pointed out that international space law is the most established segment of the considered jurisprudence. It is concluded that rapid strides are being taken in space technology and that these developments will make the emergence of space law rapid and dynamic. G.R.

A87-10505
LIABILITY OF THE UNITED STATES GOVERNMENT FOR OUTER SPACE ACTIVITIES WHICH RESULT IN INJURIES, DAMAGES OR DEATH ACCORDING TO UNITED STATES NATIONAL LAW
J. A. BOSCO (John J. Kennelly and Associates, Chicago, IL) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 51, Summer 1986, p. 809-895. refs

The present article is concerned with the involvement of the U.S. government in outer space activities, the parameters of U.S. liability under U.S. law, and the obstacles associated with seeking redress for injury, damages, or death from the federal government. It is pointed out that U.S. domestic law differs greatly from U.S. international law regarding the liability of the U.S. government for outer space activities to persons damaged, injured, or killed. As a result, American citizens under domestic law and foreign nationals under international law may be treated differently. The doctrine of sovereign immunity is discussed, and questions regarding the liability under the Federal Tort Claims Act (FTCA) are examined. The FTCA will be applicable to claims for redress for damages, injuries, or death arising out of direct or indirect U.S. outer space activities. Attention is given to substantive limitations, applicable law and venue, limited jurisdictional parameters, and particular exceptions. G.R.

A87-10508
THE ROLE OF CHOICE OF LAW IN DETERMINING DAMAGES FOR INTERNATIONAL AVIATION ACCIDENTS
K. S. CAGLE Journal of Air Law and Commerce (ISSN 0021-8642), vol. 51, Summer 1986, p. 953-1006. refs

The increase in international air travel has not prompted uniformity among the laws governing damage awards to passengers injured in international flight. An investigation is conducted regarding the various agreements and regulations which may be involved in the determination of damages for international flight accidents. An analysis is performed of the liability limits available under the Warsaw system and the manner in which they are applied. Flights not covered by the Warsaw system are also considered, taking into account the foreign laws limiting liability, American approaches regarding the choice of law analysis, and foreign approaches to choice of law analysis. It is found that the choice of law analysis can lead to widely divergent damage awards. Attention is given to efforts to amend the Warsaw Convention and the Hague Protocol in Guatemala City in 1971, the Montreal Protocols adopted in 1975, and an alternative which provides uniformity among damage awards in international transportation. G.R.

A87-10509
KEEP YOUR EYE ON THE BIRDIE - AIRCRAFT ENGINE BIRD INGESTION
R. A. MICHAEL Journal of Air Law and Commerce (ISSN 0021-8642), vol. 51, Summer 1986, p. 1007-1035. refs

In connection with the increasing speed of modern aircraft, the problem referred to as 'bird strike' has become a hazard to aircraft. This is particularly true in the case of turboprop and jet aircraft. This article is concerned with the hazard posed to aircraft when birds are ingested into aircraft engines. A description is presented of federal regulations which recognize the hazard that birds pose to aircraft by requiring aircraft engines to continue operation following bird ingestion. Bird ingestion crashes and cases are discussed, taking into account the 'Boston Electra' litigation, the 'Executive Aviation' litigation, the 'Miree' litigation, the 'Hawaiian Airlines' litigation, and the modern trend. Attention is given to the various theories of liability proposed by plaintiffs, the legal defenses available, and possible methods and procedures for avoiding bird ingestion. G.R.

A87-12249
REGULATORY REFORM - NATIONAL JURISDICTION (DOMESTIC LAW) VERSUS INTERNATIONAL JURISDICTION (BILATERAL AIR AGREEMENTS)
H. A. WASSENBERGH Air Law (ISSN 0165-2079), vol. 11, June 1986, p. 106-122. refs

The roles of individual states in the regulation of international air traffic are discussed and procedures followed in licensing airlines within a foreign country are reviewed. A bilateral agreement between countries covering air traffic supersedes unilateral decisions within the countries, e.g., abrupt impositions of excessive tariffs. International agreements are a de facto prohibition on any real deregulation of airlines since governments do not relinquish control of foreign air commerce within national boundaries. The impacts of bilateral agreements on competition and health of air transport companies are discussed, as is the dominant position of the U.S. in the shaping of international air traffic regulation practices. It is concluded that regulation of international traffic is accomplished through compromise among nations. M.S.K.

A87-14968* National Aeronautics and Space Administration, Washington, D.C.
SPACE STATION - RISKS AND VISION
K. PEDERSEN (NASA; Georgetown University, Washington, DC) Journal of Space Law, vol. 14, no. 1, 1986, p. 1-13. refs

In assessing the prospects of the NASA Space Station program, it is important to take account of the long term perspective embodied in the proposal; its international participants are seen as entering a complex web of developmental and operational interdependence of indefinite duration. It is noted to be rather unclear, however, to what extent this is contemplated by such potential partners as the ESA, which has its own program goals. These competing hopes for eventual autonomy in space station operations will have considerable economic, technological, and political consequences extending well into the next century. O.C.

A87-16044#
THE NEXT GIANT LEAP IN SPACE - AN AMERICAN CITIZENS' STUDY OF THE PROSPECTS FOR INTERNATIONAL COOPERATION IN SPACE
A. FLORINI (United Nations Association of the United States of America, New York) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 13 p.
(IAF PAPER 86-357)

Attention is given to a United Nations Association study of the foreign policy side of U.S. space policy. Topics examined include the prospects for international cooperation in space, the role of international institutions in facilitating that cooperation, and the impact of existing and potential military space activities on civilian cooperation. It was concluded that two goals can best draw nations together in a mutually advantageous space venture: the exploration of Mars and the study of earth. K.K.

A87-16101#
THE POLICY FRAMEWORK FOR SPACE COMMERCIALIZATION DISTINGUISHING RHETORIC AND REALITY
J. M. LOGSDON (George Washington University, Washington, DC) IAF, International Astronautical Congress, 37th, Innsbruck, Austria, Oct. 4-11, 1986. 5 p.
(IAF PAPER 86-448)

U.S. space-transportation policy before and after the Challenger disaster is examined critically, with a focus on the implications for space commercialization. It is argued that past NASA policy discouraged commercial launch services by subsidizing Shuttle services. The independent assessment of all program claims and the evaluation of alternative programs on the basis of clear goals are recommended. In particular, careful analysis of the demand for commercial launch services and microgravity-processing facilities in the 1990s, and of the commercial availability of space on the Space Station is urged. T.K.

A87-18415
CONSULTATION REGIME IN INTERNATIONAL SPACE LAW
M. NAKAMURA (Otaru University of Commerce, Japan) IN: International Symposium on Space Technology and Science, 14th, Tokyo, Japan, May 27-June 1, 1984, Proceedings . Tokyo, AGNE Publishing, Inc., 1984, p. 1671-1674. MOESC-supported research. refs

There are some concluded treaties and draft treaties under discussion in the area of international space law. There has been a tendency to control controversies between the states' parties by the 'consultation procedure' in these treaties and draft treaties. This procedure consists of three phases: (1) prior notification of the plan, (2) the right of the affected state to request consultation, and (3) the duty of the affecting state to enter into consultation. Author

A87-18454* National Aeronautics and Space Administration, Washington, D.C.
SPACE STATION - A MODEL FOR FUTURE COOPERATION IN SPACE
W. P. RANEY (NASA, Office of Space Station, Washington, DC) IN: Space exploitation and utilization; Proceedings of the Symposium, Honolulu, HI, December 15-19, 1985 . San Diego, CA, Univelt, Inc., 1986, p. 47-51.
(AAS PAPER 85-600)

Advances in the ability to operate in, and thus to exploit, space have come more rapidly than almost anything else that has been done. From the beginning, nations have engaged in both cooperation and competition, from the stage of adventurous exploration to the current routine commercial activity. The Space Station program serves as a focus for the free world to move forward together, sharing both risks and benefits during the initial, formative period of an entirely new level of capability. Author

A87-18668
LAW GOVERNING OUTER SPACE ACTIVITIES - ITS CONCEPT, TERMINOLOGY, SCOPE AND SUBJECTIVITY
A. GORBIEL (Lodz, Uniwersytet, Poland) Postepy Astronautyki (ISSN 0373-5982), vol. 19, no. 1-2, 1986, p. 123-136. refs

The fundamentals of legislation regarding space activities are examined. The concept of space law and applicable terminology, such as interplanetary laws, are studied and defined. Consideration is given to the international and national aspects of space laws. The subjectivity and range of operation of space laws are discussed. I.F.

A87-18862#
NEW TECHNOLOGY AND PATENTS
D. B. NEWMAN, JR. IN: Aerospace Computer Security Conference, 2nd, McLean, VA, December 2-4, 1986, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1986, p. 102-105. refs
(AIAA PAPER 86-2786)

A device using new technology developed after a patent has issued can infringe that patent under the Doctrine of Equivalents. An inventor is required to disclose the best mode known to him for practicing his invention at the time of filing for a patent; however, he is not required to predict all future developments which will enable practice of the invention. Author

A87-19299
THE WARSAW CONVENTION BEFORE THE SUPREME COURT - PRESERVING THE INTEGRITY OF THE SYSTEM
S. C. JOHNSON and L. N. MINCH (Lillick, McHose and Charles, San Francisco, CA) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 52, Fall 1986, p. 93-116. refs

Court cases regarding the liability policies of the Warsaw Convention are discussed. The enforceability of the convention's liability ceiling and the prerequisites for liability are examined. The applicability of the Warsaw Convention to international flights and related ground activities is evaluated. I.F.

A87-19300
RECENT DEVELOPMENTS IN AVIATION CASE LAW
R. D. MARGO (Condon and Forsyth; California, University, Los Angeles) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 52, Fall 1986, p. 117-190. refs

Cases concerned with the liability aspects of aviation litigations are analyzed. Consideration is given to jurisdiction on the federal and personal levels, and the liabilities of air carriers, manufacturers, and the U.S. government. The awarding of damages based on mental anguish and emotional distress, post-traumatic stress disorders, and preimpact and post-impact pain and suffering, and the types of insurance policies available to air carriers are examined. I.F.

A87-20680
INTERNATIONAL COOPERATION - NEW INITIATIVES IN SPACE
RICHARD R. COLINO (INTELSAT, Washington, DC) Spaceflight (ISSN 0038-6340), vol. 28, July-Aug. 1986, p. 282-288.

The need for international cooperation in space missions is examined. Consideration is given to the individual space programs of the Soviet Union, China, Japan, and Western Europe, and the Spacelab and proposed Space Station missions. The international cooperation involved in the formation of Intelsat, and the proposed development of an aerospace vehicle are discussed. I.F.

A87-21258
OUTER SPACE AND COSMOPOLITICS
STEPHAN F. VON WELCK (Deutsche Gesellschaft fuer Auswaertige Politik, Bonn, West Germany) Space Policy (ISSN 0265-9646), vol. 2, Aug. 1986, p. 200-205. refs

Various issues of power politics in outer space are examined. The space programs of the USSR and USA which are concerned with the exploration, control, and use of outer space are reviewed. The use of space transport systems, artificial satellites, space stations, and ground stations to explore space in order to gain 'cosmopolitical' power, and treaties and laws aimed at limiting the dominance of the superpowers are discussed. The role of Western Europe in providing a balance in the concentration of space power is considered. I.F.

A87-23266
THE POLITICAL IMPACT OF REMOTE SENSING
E. R. C. VAN BOGAERT (Gent, Rijkuniversiteit, Ghent, Belgium) IN: Air worthy . Deventer, Netherlands and Norwell, MA, Kluwer Law and Taxation Publishers, 1985, p. 35, 37-46. refs

An historical and analytical account is given of the development of space law bearing on matters of remote sensing of the earth from orbital space. It is noted in view of historical experience in this field that the prospects for regulation of remote sensing fundamentally depend on the harmonization of conflicting interests among sovereign states. The achievement of concensus concerning the legal status of remote sensing is not hindered by east-west distrust of ulterior motives as much as by the economically motivated claims of Third World nations, which are substantially strengthened in internation politics by the majority voting block these nations constitute in the United Nations. O.C.

A87-23268
DEREGULATION OF AIR TRANSPORT IN NORTH AMERICA AND WESTERN EUROPE
P. P. C. HAANAPPEL (McGill University, Montreal, Canada) IN: Air worthy . Deventer, Netherlands and Norwell, MA, Kluwer Law and Taxation Publishers, 1985, p. 89, 91-115. refs

Airline deregulation is firmly established in the United States. It is presently suggested that Canada will follow suit. On North Atlantic routes between the U.S. and a large number of ECAC nations, 'zones of reasonableness' for tariffs will remain in force for at least two years. In western Europe, EEC bodies prefer the liberalization of intra-European air transport regulations, with only the British and Dutch governments fully embracing deregulation. It is further suggested that EEC deregulation is inevitable in virture of larger trends toward lower regulation in mature air transport markets, and reductions in governmental involvement in the economy as a whole. O.C.

A87-23270
EUROCONTROL - LIABILITY AND JURISDICTION
A. E. DU PERRON (Court of Appeal, Leeuwarden, Netherlands) IN: Air worthy . Deventer, Netherlands and Norwell, MA, Kluwer Law and Taxation Publishers, 1985, p. 135, 137-149. refs

Six west European countries created 'Eurocontrol' in March of 1963 and entrusted it with air traffic services in the 'upper airspace' of the Flight Information regions for which each of them was responsible. In a Protocol promulgated on February 12, 1981, the Eurocontrol Convention recognized that the separation between upper and lower airspace had become impractical in view of jet aircraft operations in short range as well as long range routes. An evaluation is presently made of all other aspects of the Eurocontrol organization not affected by this Protocol. O.C.

A87-23274
THE 'RIGHT TO FLY' AND THE 'RIGHT TO CARRY TRAFFIC BY AIR', IN INTERNATIONAL AIR TRANSPORTATION, AFTER 40 YEARS
H. A. WASSENBERGH (Leiden, Rijksuniversiteit, Netherlands) IN: Air worthy . Deventer, Netherlands and Norwell, MA, Kluwer Law and Taxation Publishers, 1985, p. 215, 217-233. refs

The 'right to fly' would exist if there was effective freedom of the air, but sovereignty of States over their territorial airspace is in fact complete. This same basis of State sovereignty over national airspace is the starting point for the economic regulation of civil aviation. The present discussion of the consequences of this state of affairs in international law notes that the distinction between the different freedom categories is obsolete as an objective basis for the determination of capacity; the origin and destination of traffic being difficult to establish objectively, embarkation and disembarkation are considered to be more practical terms. O.C.

A87-23748
SPACE STATION'S UNEASY ALLIANCE
PETER BACKLUND Space World (ISSN 0038-6332), vol. W-11-275, Nov. 1986, p. 8-10.

The Space Station, NASA's major initiative for the next decade, is described as the agency's most expensive program since the Space Shuttle and the first with no clear end point. NASA is not alone: invitations to participate have been accepted by Japan, Canada and the European Space Agency (ESA). The current negotiations over who will build what seem to be a technical issue but are a preview of what faces the partners in the future, when they tackle such issues as management of the Station, legal and property rights, and division of operational costs. ESA is to provide one of the four attached laboratory modules clustered at the center of the complex, plus a 'free-flying' platform for earth-viewing instruments in polar orbit. Japan will furnish one of the attached modules and Canada will furnish an advanced version of the Shuttle robot arm. ESA has a long-term European Space Plan 'to maintain and develop European independent capabilities in space' with Ariane commanding nearly half the market for commercial launches. These factors have led ESA to get recognition as a 'full junior partner' with the U.S. ESA's proposal to develop a detachable Columbus laboratory is a difficult topic of negotiation with NASA's initial rejection of the concept at first resulting in an impasse. Negotiations resumed when ESA reassured NASA that Columbus would be attached to the Station but would be designed from the start with the capacity to make short duration, man-tended free flyer missions for both U.S. and international users. D.H.

A87-25446
THE SPACE INSURANCE MARKET - PROBLEMS AND SOLUTIONS
ROBERT J. TIRONE (Alexander & Alexander Inc., New York, NY) International Space Business Review, vol. 1, July-Aug. 1986, p. 52-54.

Problems for the continued commercialization of space caused by the continued deterioration of the space insurance market are discussed. The main problems include the tremendous escalation of premium costs, restrictions on the amount of insurance placed on any given offering and on the scope of coverage offered to prospective satellite owners, and insufficient time between commitment by insurers and launch. The actions that should be undertaken by insureds, launch agencies, the financial community, the U.S. government, and the insurance broker to develop a viable space insurance market are considered. C.D.

A87-25530
SPACE INSURANCE - COMMENTS FROM AN OBSERVER
JOEL S. GREENBERG and CAROLE GAELICK (Princeton Synergetics, Inc., NJ) Space Policy (ISSN 0265-9646), vol. 2, Nov. 1986, p. 307-321. refs

Insurance rate setting problems are studied using examples. The first example involves the establishment of third-party liability insurance rates and the second example is concerned with launch insurance. The implications of mission modes, failure/recovery paths, and multiple correlated payloads are discussed. Computer simulations techniques for analyzing insurance policies and rate structures for specific payloads are described. The computer simulations provide data on insurance policies and premiums for individual flights and combinations of flights and the cash-flow statistics of the space insurance industry as a function of the number and type of satellite launches, satellite configuration, insurance policy, and premium structures. I.F.

A87-26751
TRACING NEW ORBITS: COOPERATION AND COMPETITION IN GLOBAL SATELLITE DEVELOPMENT
DONNA A. DEMAC, ED. New York, Columbia University Press, 1986, 347 p. For individual items see A87-26752 to A87-26766.

The history, status and future directions of international agreements and organizations which operate and regulate satellite communications systems are discussed. The evolution, capabilities and future plans of the Intelsat organization are described, as are attempts to develop privately operated systems to compete directly with Intelsat services. Deficiencies in Intelsat services to LDCs and international corporations are noted. Efforts by less developed countries (LDCs) to establish a priori assignment of frequencies and GEO positions through ITU WARC legislative maneuvering are summarized, along with the benefits which LDCs have received from Intelsat operations under a free access policy and U.S. WARC strategies to ensure that free access continues. Soviet cooperative international space ventures and in the Intersputnik program are outlined, and the operation of U.S. receivers for Molniya television broadcasts is described. M.S.K.

A87-26752
THE SEARCH FOR A STABLE REGULATORY FRAMEWORK
CARL Q. CHRISTOL (Southern California, University, Los Angeles, CA) IN: Tracing new orbits: Cooperation and competition in global satellite development . New York, Columbia University Press, 1986, p. 3-18. refs

Presently existing and possible future legal frameworks for guiding international space activities are summarized. The activities of the ITU and the United Nations COPUOS branch are described, along with major provisions of the 1967 Treaty on Outer Space. Treaty articles which cover the peaceful exploitation of space resources, assign liability for damage arising from space activities, and limit the types of weapons in space are noted. A new international regulatory institution may be needed to resolve and seek solutions to problems such as the accumulation of space debris, the continued commercial development of space in the face of growing military interest in space capabilities, the regulation of international space stations, etc. Finally, limitations on existing agreements governing the exploitation of lunar resources are outlined. M.S.K.

A87-26758
CANADA'S SPACE POLICY
W. M. EVANS (Ministry of State for Science and Technology, Canada) IN: Tracing new orbits: Cooperation and competition in global satellite development . New York, Columbia University Press, 1986, p. 130-140.

Historically, the Canadian space program has been targeted at meeting national needs while developing an indigeneous space operations and manufacturing industry. Full government funding of communications satellites has tapered off as private industry contributions eventually became fully responsible for the Isis II spacecraft. Other projects, e.g., the Shuttle RMS, ANIK-B, and the ESA L-Sat, were international in scope. Canada has a satellite integration and environment testing facility and a company, SPAR Aerospace, Ltd., that has the expertise to act as prime contractor for satellite programs. The MSAT program being investigated as a joint effort of public and private Canadian and U.S. concerns is to establish a common mobile, satellite-based communications capability. M.S.K.

A87-26759
RESEARCH AND DEVELOPMENT POLICY IN THE UNITED STATES IMPLICATIONS FOR SATELLITE COMMUNICATIONS
FRED W. WEINGARTEN and CHARLES WILK (U.S. Congress, Office of Technology Assessment, Washington, DC) IN: Tracing new orbits: Cooperation and competition in global satellite development . New York, Columbia University Press, 1986, p. 141-155. refs

The Federal policy role in communications satellite technology is discussed on the basis of a 1985 Office of Technology Assessment report on the state of R&D on information technology. Federal funding of R&D for communications research for military purposes, to stimulate commercial development, to enlarge the fundamental database on communications theory and to link together laboratories performing fundamental research, and for improving foreign relations. Although most R&D funds are spent by the military, NASA has developed the technologies which have been employed by private concerns to develop new telecommunications industries. M.S.K.

A87-26761
PIRACY OF SATELLITE-TRANSMITTED COPYRIGHT MATERIAL IN THE AMERICAS - BANE OR BOON?
SYLVIA OSPINA IN: Tracing new orbits: Cooperation and competition in global satellite development . New York, Columbia University Press, 1986, p. 166-198. refs

The theft of satellite-broadcast U.S. copyrighted material by receivers in the Americas is discussed. The signals, broadcast from GEO spacecraft, fall on countries between the U.S. and the equator and can be received with dish antennas a few feet in diameter. Sometimes it is the local government that does the signal poaching for rebroadcast. No fees are paid for the 'pirated' broadcasts, while the development of indigenous entertainment industries is undercut. Although no international treaty carries the force to stop the piracy, the U.S. can and has withheld foreign aid to countries known to be pirating broadcasts. It is concluded that only by scrambling the signals can broadcast copyrights be protected. M.S.K.

A87-26763
THE ROLE OF INTERNATIONAL SATELLITE NETWORKS
WILSON DIZARD (Georgetown University, Washington, DC) IN: Tracing new orbits: Cooperation and competition in global satellite development . New York, Columbia University Press, 1986, p. 222-250.

The strategy to be followed by the U.S. at the 1985 and 1988 WARC meetings are discussed. The goal is to maintain the flexible access to the GEO positions and available frequency bands now in place. It is expected that less developed countries, with no

present plans of placing satellites in GEO, will seek definite assignments of frequencies and positions. Freedom of access, however, is the reason satellite-based telecommunications systems were developed so rapidly. It is essential to preserve the freedom of access if technological development is to continue at a pace that will satisfy current and future users. The needs of Common User Organizations such as Intelsat must guide the ITU in overseeing the development of space resources by both developed and less-developed nations. M.S.K.

A87-29483
ANNALS OF AIR AND SPACE LAW. VOLUME 10
NICOLAS MATEESCO MATTE, ED. (McGill University, Montreal, Canada) Montreal, McGill University, 1985, 626 p. In English and French. For individual items see A87-29484 to A87-29494.

Recent legal developments regarding conventions and treaties which guide the worldwide development of air transportation, civil, commercial and military satellite-based operations, and expanding space station programs are explored. Consideration is given to the assignment of liability for operators of transport terminals, aircraft operators and in Japan. Procedures developed by a neutral state to respond to intrusion into national airspace by a foreign aircraft are discussed. Various European programs to develop multinational DBS and radio broadcast satellites are described, with emphasis on the international implications of transnational media broadcasts. Finally, existing international legal conventions governing space station operations are identified. M.S.K.

A87-29494#
SPACE STATIONS - A PEACEFUL USE FOR HUMANITY?
NICOLAS MATEESCO MATTE (McGill University, Montreal, Canada) IN: Annals of air and space law. Volume 10 . Montreal, McGill University, 1985, p. 417-451. refs

The history of NASA and Soviet Space Station activities and constraints placed on Space Station activities by international agreements are explored. The Soviets launched the first Salyut Space Station in 1971, followed by launch of Skylab in 1973. The Soviets have since orbited several Salyut modules while NASA was developing the Shuttle, which was at first to be the supply vessel for a Space Station but has become the primary launch vehicle. The initiation of a U.S. Space Station program has become an international effort, primarily exploiting European capabilities developed in the Spacelab program. The Space Station will be governed by all current conventions regulating the use of outer space. Issues of registration and liability for Space Station components are discussed. M.S.K.

A87-31425
ENVOYS OF MANKIND: A DECLARATION OF FIRST PRINCIPLES FOR THE GOVERNANCE OF SPACE SOCIETIES
GEORGE S. ROBINSON (Smithsonian Institution, Washington, DC) and HAROLD M. WHITE, JR. (North Carolina, University, Chapel Hill) Washington, DC, Smithsonian Institution Press, 1986, 312 p. refs

Legal aspects and philosophical ramifications of space exploration and colonization are discussed, and a declaration of independence and constitution for permanent inhabitants of space are presented. The gradual broadening of NASA astronaut-selection criteria is interpreted as an indicator of a trend which, along with the space environment and the artificial habitat it necessitates, might eventually make space colonists psychologically or biologically different from the earth population. The provisions of current United Nations legislation and international agreements governing the use of space are reviewed; and the legal implications of new definitions of humankind and permanent residence in space are considered. It is argued that space explorers and colonists should represent all mankind rather than national states or ethnic groups, and that they should be allowed to develop their own laws and social organization free of interference from earth. T.K.

A87-32571
DEVELOPMENTS IN SPACE LAW - CURRENT BASE AND FUTURE REQUIREMENTS
STEPHEN E. DOYLE (Aerojet TechSystems Co., Sacramento, CA) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2 . Tokyo, AGNE Publishing, Inc., 1986, p. 2209-2216. refs

The existing space law, which has been evolving since the 1950s, contains many globally accepted general principles and many specific details of a regulatory and operational nature; but it is primarily institutional law that deals with the actions of nations and organizations. In the final quarter of this century, and in the next century, space law will have to deal more specifically and more often with individuals and the rights and actions of people rather than institutions. This shift in emphasis has begun and it will increase with time. The orbiting of national and international space stations and permanently manned space facilities will present new needs for law. The status of the individual and the applicable law must be defined. Methods and agents for the exercise of jurisdiction must be clarified, and a number of traditional concepts of law, including sovereignity, ownership, proprietary rights and patents, will be re-examined and may be changed. Author

A87-34594
INTERNATIONAL COOPERATION IN SPACE
CRAIG COVAULT Commercial Space (ISSN 8756-4831), vol. 2, no. 4, Winter 1987, p. 16-19.

High costs and potential benefits of space activities are beginning a new era of global partnerships, with international space competition remaining important but gradually giving way to international cooperation. French Spot Earth resources satellite images are being marketed worldwide, the European Ariane booster has a 50 percent share of the world launch market, and the People's Republic of China is attracting international payloads for launch from its Xichang site. International participation on spaceflights is increasing, both on the Soviet Soyuz, Salyut and Mir spacecraft and on the U.S. Shuttles. The international Halley armada is another example of global cooperation. The international space picture is changing because of a new technologies in many nations, and the involvement of more countries (India, China, Japan, the Europeans). Five UN space treaties are in force, and a high degree of space cooperation for the 1990's seems likely. D.H.

A87-34597
THE STATION IS RAISING LOTS OF QUESTIONS ABOUT SPACE LAW
Commercial Space (ISSN 8756-4831), vol. 2, no. 4, Winter 1987, p. 43, 45.

The U.S./international space station program may give rise to unprecedented legal questions when it becomes operational, questions involving disputes opver such things as criminal activity on the station, industrial espionage, intellectual property rights in space, export law, and product liability. agreements among the four space partners - the U.S., Canada, Japan, and the European Space Agency - are needed to clarify the legal questions. Experts believe that some existing laws can be transferred to space, but others will be inapplicable. If the U.S. were to assert sole jurisdiction over the station, other countries could choose to withdraw their participation. Having 'national enclaves' aboard the station is unacceptable to the U.S. Setting up an international governmental organization, such as Intelsat, might be a possibility. A measure to extend U.S. patent laws to cover devices invented aboard launch vehicles and spacecraft is expected to be brought up again during the current legislative session. Although some members of Congress are concerned about adequate protection of U.S. interests, some experts think it would be best to wait and write the laws when the need for them is specifically evident. Author

A87-35448
TECHNOLOGY TRANSFER AND SECOND SOURCING WHEN PRODUCTION COSTS FOLLOW AN EXPERIENCE CURVE
JAMES E. HODDER (Stanford University, CA) and YAEL A. ILAN (Technion-Israel Institute of Technology, Haifa) IEEE Transactions on Engineering Management (ISSN 0018-9391), vol. EM-34, Feb. 1987, p. 36-41. refs

A modification of the model of Spence (1981) is used to evaluate technology transfer agreements between firms when production costs decline with experience, and the Net Present Value for a product is calculated under a variety of conditions. Specific situations which are found to be advantageous for the potential licensor, including licensing in response to a second-source requirement by a large potential customer, are considered. The desirability of technical assistance and the implications of various compensation agreements are also discussed. The model is found to predict observed licensing phenomena such as the strong preference of firms for Foreign Direct Investment over international licensing of new technology. R.R.

A87-37016
AVIATION ANTITRUST - INTERNATIONAL CONSIDERATIONS AFTER SUNSET
PATRICIA BARLOW Air Law (ISSN 0165-2079), vol. 12, Feb. 1987, p. 11-28. refs

The role of antitrust laws in the international air transportation industry during the transition from a regulated to a deregulated economic environment is studied. Antitrust laws and the air transportation industry prior to 1978 are examined. Consideration is given to the antitrust authority of the CAB under the Federal Aviation Act of 1958, the doctrines of primary and exclusive jurisdiction, and express and implied antitrust immunity provisions. The factors which caused the deregulation of the air transportation industry in 1978, such as the approval of the Skytrain concept, negotiations of liberal bilateral air transport agreements, and the IATA Show Cause Order, are discussed. I.F.

A87-37566
THE ROLE OF THE INTERNATIONAL CIVIL AVIATION ORGANIZATION ON DEREGULATION, DISCRIMINATION, AND DISPUTE RESOLUTION
PAUL STEPHEN DEMPSEY (Denver, University, CO) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 52, Spring 1987, p. 529-583. refs

The role of ICAO in maintaining efficient international air transportation is discussed. The extraterritorial application of national legislation regarding antitrust and competition is examined. Considertion is given to the establishment and enforcement of international air carrier tariffs, the elimination of bias in airline computer reservation systems, preventing discrimination in airport navigation and user fees, and the reciprocal elimination of foreign taxation. The ICAO procedures for resolving disputes, and various types of sanctions are described. Examples of dispute resolutions are provided. I.F.

A87-37970
INTERNATIONAL OUTER SPACE LAW
CHRISTOL (Southern California, University, Los Angeles, CA) Space Policy (ISSN 0265-9646), vol. 3, Feb. 1987, p. 65-71. refs

Principles of space law are examined in terms of the relations between states. Existing treaties governing the use of space are considered in terms of protection and responsibility and control and registration of launched objects. The roles of the UN and the International Telecommunication Union in the development of international space laws are discussed. I.F.

A87-38474
TOWARDS A NEW LEGAL REGIME FOR THE USE OF NUCLEAR POWER SOURCES IN OUTER SPACE
QIZHI HE Journal of Space Law, vol. 14, no. 2, 1986, p. 95-112. refs

The development of a new legal regime for the use of nuclear power sources (NPSs) in outer space is discussed. The types of NPSs utilized in space, their advantages, and the potential hazards to man and the environment from a malfunctioning NPS are described. The deliberations of the UN committee on Peaceful Uses of Outer Space in regards to the scientific, technical, and legal aspects of using NPSs in outer space are examined. Consideration is given to the development of laws governing the notification of launches or malfunctions of NPSs, the providing of assistance in tracking of the reentry of a malfunctioning NPS, liability for damages caused by NPSs, and safety measures. I.F.

A87-38475
MANUFACTURERS' LIABILITY UNDER UNITED STATES LAW FOR PRODUCTS USED IN COMMERCIAL SPACE ACTIVITIES
RANDAL R. CRAFT, JR. (Partner, Haight, Gardner, Poor, and Havens, New York) Journal of Space Law, vol. 14, no. 2, 1986, p. 113-139. refs

The application of U.S. product liability laws to determine the liability of manufacturers' for personal injury, property damage, and economic losses caused by the use of a manufacturer's product in commercial space activities is examined. The factors studied by U.S. courts in order to determine what laws to apply to product liability cases are discussed. The Outer Space Treaty of 1967, the Liability Convention of 1972, and the Registration Convention of 1974 are reviewed in terms of liability. Product liability law in the U.S. is analyzed with particular consideration given to maritime law, the defense of a government contractor, the application of strict liability, the types of damages recoverable, contractual disclaimers, and product liability insurance. Some legislative reforms dealing with product liability law are described. I.F.

A87-40162
NATIONAL SPACE LAW IN EUROPE [NATIONALE WELTRAUMGESETZE IN EUROPA]
JUERGEN REIFARTH Zeitschrift fuer Luft- und Weltraumrecht (ISSN 0340-8329), vol. 36, March 1987, p. 3-16. In German. refs

Some laws governing space activities in Europe, in particular those of ESA members, are reviewed. The responsibilities of the states and private companies regarding the control of space operations are examined in terms of existing space treaties. The Swedish Act and Decree of 1982 on Space Activities, and the U.K. Outer Space Act of 1986 concerned with the regulation of space activities, the licensing of objects launched into space, and liability for damages and injury are discussed. Laws governing state and private space projects in Germany are analyzed. I.F.

A87-40164
PROJECTING THE NEXT FIFTY YEARS OF THE SPACE AGE - THE REPORT OF THE U.S. NATIONAL COMMISSION ON SPACE
MARCIA S. SMITH (U.S. National Commission on Space, Washington, DC) Zeitschrift fuer Luft- und Weltraumrecht (ISSN 0340-8329), vol. 36, March 1987, p. 47-51.

The recommendations of the U.S. NCOS, presented in May 1986, regrading the future development of the U.S. civilian space program are studied. The commission proposed the opening of the inner solar system for science, exploration, and development. Research in the areas of automated space science, manned space flight, space applications, and space enterprise is recommended. The development of low cost transportation in the form of cargo and passenger vehicles and the establishment of settlements on the moon and Mars are examined. The feasibility of the program is discussed. Consideration is given to the need for space laws in such areas as space debris control, common docking system, and the safe use of nuclear power in space. I.F.

A87-41223
THE USA AND INTERNATIONAL COMPETITION IN SPACE TRANSPORTATION
RAY A. WILLIAMSON (U.S. Congress, Office of Technology Assessment, Washington, DC) Space Policy (ISSN 0265-9646), vol. 3, May 1987, p. 115-121. refs

The response of U.S. space policy to increasing international competition in the commercial launch market is examined critically, in part on the basis of the OTA report 'International cooperation and competition in civilian space activities' (1985). Status reports on policy and technological capabilities (both U.S. and international) for 1982, 1987, and 1992 are presented and compared, and conflicting policies and a lack of clearly defined goals are identified as continuing problems. Recommendations for the immediate future include intensive further development of new space-transportation systems with full industry cooperation from an early stage, formulation and implementation of policies to assist the industry in providing commercial launch services, more industry willingness to take risks and lower costs, and integration of space-transportation policy with overall space policy. T.K.

A87-42178
THE ISSUE OF PRIVATE UNITED STATES INTERNATIONAL SATELLITE SYSTEMS SEPARATE FROM INTELSAT
JOHN B. GANTT (Hunton and Williams, Washington, DC) Space Communication and Broadcasting (ISSN 0167-9368), vol. 5, March 1987, p. 5-21. refs

The restructuring of the manner in which communications services are provided in the U.S. is examined. The importance of cooperation in international communications is discussed. Issues related to one or more foreign-owned systems entering the U.S. communications market are analyzed. U.S. policy decisions regarding separate satellite systems, and FCC decisions and policy implementation favoring private international satellite systems, are described. The possibility of a multinational consultation identifying future global communications needs and the methods for meeting these needs is considered. I.F.

A87-42180* National Aeronautics and Space Administration, Washington, D.C.
THE STRUCTURING OF NASA LAUNCH CONTRACTS
JOHN E. O'BRIEN (NASA, Washington, DC) Space Communication and Broadcasting (ISSN 0167-9368), vol. 5, March 1987, p. 31-36. refs

The designing of STS Launch Services Agreements (LSAs) in order to balance the U.S. public policy concerns and the needs of domestic and foreign users is described. The subject matter of an LSA is defined by the customer's needs; when and what will be launched is also stated in the LSA. The technical requirements of the launch are contained in the Payload Integration Plan. The price for launching payloads is determined based on factors such as payload control weight and length. The allocation of risks and liability for damage to person and property involved in STS operations is examined; a cross-policy waiver governs property damage, and third-party liability coverage is required. Consideration is given to the policy governing reflying of a commercial mission in the event of an initial failure and to modified LSAs. I.F.

A87-42858
ANNALS OF AIR AND SPACE LAW. VOLUME 11
NICOLAS MATEESCO MATTE, ED. (McGill University, Montreal, Canada) Montreal, McGill University, 1986, 500 p. In English and French. For individual items see A87-42859 to A87-42868.

Papers are presented on the effect of automation on the airline industry, ICAO and the joint financing of certain air navigation service, the liability of the U.S. government in cases of air traffic controller negligence, ICAO recommendations to combat terrorism, the identification and interception of civil aircraft, and the effect of European laws on air transportation. Topics discussed include: developments in jurisprudence for air carrier responsibility related to the Warsaw Convention system, space commercialization activities, satellite telecommunications, the role of the UN in treaty law and outer space, the registration of objects launched into space, and international verification procedures. Consideration is given to the role of private corporations in international satellite telecommunications, various international aeronautical organizations, leading cases in aviation law, and legislative tests. I.F.

A87-42865#
SOME THOUGHTS ON THE COMMERCIALIZATION OF SPACE ACTIVITIES [QUELQUES REFLEXIONS SUR LA COMMERCIALISATION DES ACTIVITES SPATIALES]
MICHEL G. BOURELY IN: Annals of air and space law. Volume 11 . Montreal, McGill University, 1986, p. 171-186. In French. refs

The notions of the commercialization and the privatization of space are distinguished, and legal aspects of these activities are discussed. The Space Treaty of January 1967 set guidelines for the exploration and utilization of the moon and other celestial bodies. Legal aspects of the notion of exploitation, which appeared for the first time in the Accord of December 1979, remain as yet undefined. National laws adopted by the United States for the commercialization of remote sensing, vehicle launching, and telecommunications are discussed. In the Common Market, the current practice of gradually disengaging the governments from certain space activities corresponds more appropriately to the notion of privatization, though at the moment both commercialization and privatization are seen to coexist. Finally, the impact of the Space Shuttle and Ariane disasters on space commercialization is considered. R.R.

A87-42866#
TREATY LAW AND OUTER SPACE - CAN THE UNITED NATIONS PLAY AN EFFECTIVE ROLE?
NANDASIRI JASENTULIYANA (UN, Outer Space Affairs Div., New York) IN: Annals of air and space law. Volume 11 . Montreal, McGill University, 1986, p. 219-227. refs

The role of the UN in developing space laws is examined. The UN process for the creation of space laws is described. The limitations of the UN treaty process, such as the under representation of third world nations on the committees and the use of the qualified consensus rule, are discussed. I.F.

A87-46975
THE SPACE STATION: A PERSONAL JOURNEY
HANS MICHAEL MARK (Texas, University, Austin) Durham, NC, Duke University Press, 1987, 272 p.

An insider's account is given of space science policy and politics during two American presidencies that climaxed in the go-ahead for the Space Station program. The relevant technological debates are addressed in detail, including the effect of the Challenger tragedy. The development of the Shuttle and the relationship of the space program to arms control and other topics are also conssidered. C.D.

A87-47703
THE TEACHING OF SPACE LAW AROUND THE WORLD
STEPHEN GOROVE, ED. (Mississippi, University, University) University, MS, University of Mississippi Law Center (L.Q.C. Lamar Society of International Law Monograph Series, No. 4), 1986, 109 p. No individual items are abstracted in this volume.

The current status of space law teaching around the world is examined. Particular attention is given to the teaching of space law in the U.S., Canada, Argentina, FRG, Holland, Czechoslovakia, Hungary, Poland, the Soviet Union, and China. The history of teaching space law in these countries, the objectives of the course, methodology employed, treaties and materials utilized in the course, student interest, funding of courses, research and publication, and the long and short term expectations for the course are discussed. I.F.

A87-50393
DIRECT TELEVISION BROADCASTING BY SATELLITE - A NECESSITY TO SET UP UNIVERSALLY BINDING INTERNATIONAL LEGAL NORMS
ANDRZEJ GORBIEL Postepy Astronautyki (ISSN 0373-5982), vol. 19, no. 3-4, 1986, p. 39-68 . refs

The paper argues for the need for an unequivocal international legal regulation of direct television broadcasting, called for by its special political implications. The regulation proposals submitted to the United Nations by different states are discussed together with the problems connected with the individual proposals. Special attention is given to the result of the codification conducted by the U.N. Legal Outer Space Subcommittee. I.S.

A87-50792
SPACE STATION - ALL CHANGE?
CHRIS BULLOCH and JOHN RHEA Space Markets (ISSN 0258-4212), Autumn 1986, p. 164-167.

The status of the International Space Station is assessed from a European perspective. NASA's role in coordinating international cooperation is discussed. Particular attention is given to legal concerns. K.K.

A87-51323
THE FUTURE OF SPACE INSURANCE
BOB JAQUES Space Markets (ISSN 0258-4212), Summer 1987, p. 68-70.

Changes in the spacecraft insurance industry, increases in launch and in-orbit insurance rates and a reduction in insurance capacity, due to recent space failures are studied. The recommendations of the 1986 space insurance conference as regards launch and life insurance rates, capacity, advanced commitment, life coverage terms, segregated launch coverage, hardware discrimination, and the establishment of standard policy language are discussed. Alternatives to insuring launches have been proposed; they include launch guarantee schemes, users forming a pool for self insurance, purchasing spacecraft at a higher rate after they are successfully in orbit, and launching with no insurance and using additional satellites. I.F.

A87-51477
SPACE COMMUNICATIONS TO AIRCRAFT: A NEW DEVELOPMENT IN INTERNATIONAL SPACE LAW. I
WOLF D. VON NOORDEN (International Maritime Satellite Organization, London, England) Journal of Space Law, vol. 15, no. 1, 1987, p. 25-34. refs

The establishment of an international institutional framework for aeronautical satellite telecommunications is examined. The structure and current objectives of Inmarsat are reviewed. Various applications for aeronautical satellite telecommunications in the areas of air traffic services, aeronautical operational control, and aircraft passenger communications are described. The development of an aeronautical satellite system, and the role of Inmarsat in creating the communication system are discussed. I.F.

A87-52171
AVIATION TORT LITIGATION AGAINST THE UNITED STATES - JUDICIAL INROADS ON THE PILOT-IN-COMMAND CONCEPT
ANDREW J. DILK (FAA, Office of the Chief Counsel, Washington, DC) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 52, Summer 1987, p. 797-867. refs

This article discusses the weakening of the pilot-in-command (PIC) concept in aviation law, which places primary responsibility for the successful operation of the aircraft on the pilot in charge of the flight. The historical development of the PIC concept is reviewed, and the dilution of the concept by the judiciary in major cases, with increasing liability being placed on air traffic controllers, is described in detail. A new routing for aviation tort litigation under the Federal Tort Claims Act is proposed. C.D.

A87-52172
AIRLINE MANAGEMENT PREROGATIVE IN THE DEREGULATION ERA
JAMES J. MCDONALD, JR. (Fisher and Phillips, Atlanta, GA) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 52, Summer 1987, p. 869-939. refs

The application of the management prerogative concept, which holds that an employer may make decisions relating to the basic scope and direction of the enterprise without first bargaining with, or obtaining the consent of, the unions representing its employees, to the airline industry is discussed. The genesis of the concept of management prerogative is reviewed, and the scope of collective bargaining and management prerogative under the Railway Labor Act is examined. It is shown that no justification exists for construing the scope of an airline's management prerogative in most instances to be any narrower than that of nonairline employers. The applicability of the doctrine of airline management prerogative under deregulation is discussed, and procedural considerations are addressed. C.D.

A87-52173
THE COMMERCIAL SPACE LAUNCH ACT - THE REGULATION OF PRIVATE SPACE TRANSPORTATION
MICHAEL S. STRAUBEL (Valparaiso University, IN) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 52, Summer 1987, p. 941-969. refs

The legal regime created by the Commercial Space Launch Act and faced by potential United States transportation providers is explored and evaluated. The business potential for space transportation and the need for regulation are examined, and regulation prior to the Act is reviewed. The Act's provisions and the regulations promulgated to implement the Act are outlined and analyzed. The steps that should be taken to develop a viable private launch industry in the United States are briefly addressed. C.D.

A87-53099
WORLDWIDE REGULATION OF SATELLITE BROADCASTING AND COMMUNICATIONS - SOME OBSERVATIONS AND RECENT DEVELOPMENTS
JEFFREY P. CUNARD (Debevoise and Plimpton, Washington, DC) IN: Satellite communications and broadcasting; Proceedings of the International Conference, London, England, Dec. 2-4, 1986 . London, Online Publications, 1986, p. 79-108. refs

Some legal and regulatory issues in the satellite industry are discussed. Consideration is given to the national policies of the U.S., Canada, Japan, France, FRG, and Italy regarding the use and control of satellites. The difficulties involved in developing coherent regulatory policies for transnational satellite users are examined. The effects of new technological developments on the use and regulation of international satellite services are studied. It is suggested that the competitive satellite market needs to be controlled by using regulations based on natural market forces, not only deregulation. I.F.

A87-53987
INTERNATIONAL COOPERATION IN SPACE - ENHANCING THE WORLD'S COMMON SECURITY
GEORGE BROWN (U.S. House of Representatives, Washington, DC) Space Policy (ISSN 0265-9646), vol. 3, Aug. 1987, p. 166-174.

Instead of preparing for space warfare, the USA could make tremendous use of space activities to enhance global security. Arms control verification, environmental monitoring and international cooperation on space missions are important examples. International space year, 1992, could be the time to launch a triumphant effort such as an international mission to Mars. Author

A87-53994
THE USSR'S PRUDENT SPACE POLICY
ALAIN DUPAS (Paris, Universite; CNES, Paris, France) Space Policy (ISSN 0265-9646), vol. 3, Aug. 1987, p. 239-243. refs

The current status and possible future directions of the Soviet space program (SSP) are discussed, comparing statements by Soviet spokesmen with published Western intelligence estimates. The history of the SSP is traced, and its essential prudence (exploiting known technology and existing hardware to the maximum extent possible) and tenacity are stressed. It is argued that only about 55 percent of the SSP is for military purposes, and that Soviet denials of space ABM development probably reflect an actual preference for ground-based alternatives. It is suggested that international cooperation on certain SSP projects and the desire of the USSR to enter the launch-services market will make somewhat more information on the SSP available in the future. T.K.

N87-10775# Committee on Science and Technology (U.S. House).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION ACT, 1987
Washington GPO 1986 37 p An act, H.R. 5495, referred to the Committee on Commerce, Science and Transportation, 99th Congress, 2d Session, 30 Sep. 1986
Avail: US Capitol, House Document Room

Appropriations are discussed for research and development; space flight, control, and data communication; construction of facilities; and research and program management by NASA. B.G.

N87-11640# Committee on Science and Technology (U.S. House).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION ACT, 1987
Washington GPO 1986 251 p Report to accompany H.R. 5495 presented by the Committee on Science and Technology to the Committee of the Whole House on the State of the Union, 99th Congress, 2d Session, 16 Sep. 1986
(H-REPT-99-829; GPO-58-629) Avail: US Capitol, House Document Room

Authorization of appropriations to the National Aeronautics and Space Administration for the fiscal year 1987 for research and development; space flight, control, and data analysis; construction of facilities; and research and program management is discussed. B.G.

N87-11641# Committee on Commerce, Science, and Transportation (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION BILL, 1986
1986 26 p A bill, H.R. 5495, referred to the Committee on Science and Technology, 99th Congress, 2d Session, 10 Sep. 1986
(H-REPT-99-829) Avail: US Capitol, House Document Room

Authorized appropriations are summarized for the National Aeronautics and Space Administration for the following: permanently manned space station; space transportation capability development; physics and astronomy; life sciences; planetary exploration; solid earth observations; environmental observations; materials processing in space; communications; information systems; technology utilization; commercial use of space; transatmospheric research and technology; tracking and data advanced systems; space flight, control, and data communication; construction of facilities, including land acquisitions; and research and program management. B.G.

N87-11642# Committee on Appropriations (U.S. Senate).
NASA SPACE PROGRAM
Washington GPO 1986 226 p Hearings before Subcommittees of the Committee on Appropriations, 99th Congress, 2d Session, 25-26 Mar. 1986
(S-HRG-99-691; GPO-60-030) Avail: Committee on Appropriations

Topics discussed in depth include: industrial utilization and commercialization of space technology; environmental and earth science applications of space technology; intrinsic human values of space explorations; and access to space. B.G.

N87-11643# Committee on Science and Technology (U.S. House).
THE 1987 NASA AUTHORIZATION, VOLUME 1
Washington GPO 1986 171 p Hearings before the Subcommittee on Transportation, Aviation and Materials of the Committee on Science and Technology, 99th Congress, 2d Session, No. 92, 9 Apr. 1986
(GPO-60-960) Avail: Subcommittee on Transportation, Aviation and Materials

The appropriations for the National Aeronautics and Space Administration's fiscal year 1987 aeronautics and transatmospheric reasearch and technology buget requests are examined. B.G.

N87-12399# University of Southern California, Los Angeles. School of Communications.
PUBLIC PERSPECTIVES ON GOVERNMENT INFORMATION TECHNOLOGY: A REVIEW OF SURVEY RESEARCH ON PRIVACY, CIVIL LIBERTIES AND THE DEMOCRATIC PROCESS
W. H. DUTTON and R. G. MEADOW Jun. 1985 91 p Sponsored in part by Office of Technology Assessment
(PB86-218419) Avail: NTIS HC A05/MF A01 CSCL 05B

The primary purpose is to review survey research on public attitudes toward governmental uses of new communication, computing, and information technologies. Particular attention is paid to the implications of governmental information technologies for civil liberties and democratic processes. A secondary purpose is to identify generalizations about the public's views toward these issues that tend to be supported or refuted across surveys. A third and final purpose is to speculate on possible public reactions to governmental uses of emerging technologies which have implications for privacy or other civil liberties. GRA

N87-12400# Committee on Commerce, Science, and Transportation (U.S. Senate).
AUTHORIZATION OF APPROPRIATIONS FOR THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION FOR FISCAL YEAR 1987
Washington GPO Sep. 1986 85 p Report to accompany S. 2714 Presented by the Committee on Commerce, Science and Transportation of the 99th Congress, 2d Session, 29 Sep. 1986
(S-REPT-99-501; GPO-71-010) Avail: US Capitol, Senate Document Room

Information is given relative to Senate Bill 2714. This is a bill to authorize appropriations for NASA for research and development, space flight, control and data communications, construction of facilities, and research and program management, among other purposes. R.J.F.

N87-12402# Committee on Science and Technology (U.S. House).
HEARINGS BEFORE THE SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS OF THE COMMITTEE ON SCIENCE AND TECHNOLOGY, 99TH CONGRESS, 2ND SESSION, NO. 132, 25, 27 FEBRUARY; 11, 13, 20 MARCH; 9, 10 APRIL, 1986, VOLUME 2
1986 799 p
(GPO-61-777) Avail: US Capitol, House Document Room

The National Aeronautics and Space Administration fiscal year 1987 budget is examined. The impact of the loss of the Challenger and its crew on the space program is assessed. B.G.

N87-12405# Office of Science and Technology, Washington, D. C.
NATIONAL AERONAUTICAL R AND D GOALS: TECHNOLOGY FOR AMERICA'S FUTURE
Mar. 1985 13 p
(PB86-209772) Avail: NTIS HC A02/MF A01 CSCL 05A
Specific goals is three areas were addressed: subsonics, supersonics, and transatmospherics. GRA

N87-13357# Committee on Appropriations (U.S. House).
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT-INDEPENDENT AGENCIES APPROPRIATIONS FOR 1987, PART 7
1986 257 p Hearings before the Subcommittee on HUD and Independent Agencies of the Committee on Appropriations, 99th Congress, 2d Session, 13 May 1986
(GPO-61-970) Avail: Subcommittee on HUD and Independent Agencies
Appropriations for the 1987 Fiscal Year for National Aeronautics and Space Administration programs are discussed. B.G.

N87-14208*# National Aeronautics and Space Administration, Washington, D.C.
AGREEMENT BETWEEN THE GOVERNMENT OF THE FEDERAL REPUBLIC OF GERMANY AND THE GOVERNMENT OF THE UNION OF SOVIET SOCIALIST REPUBLICS CONCERNING SCIENTIFIC-TECHNICAL COOPERATION
Mar. 1986 11 p Transl. into ENGLISH of "Abkommen Zwischen der Regierung der Bundersrepublik Deutschland und der Regierung der Union der Sozialistischen Sowjetrepubliken ueber Wissenschaftlich Technischw Zusammenarbeit" Moscow, USSR, 22 Jul. 1986 p 1-9 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASW-4005)
(NASA-TM-88018; NAS 1.15:88018) Avail: NTIS HC A02/MF A01
An agreement between the government of the Federal Republic of Germany and the government of the Union of Soviet Socialist Republics concerning scientific technical cooperation is disclosed. The parties to the treaty agree to promote scientific and technical cooperation on a basis of equality, reciprocity and mutual advantage. Author

N87-15259*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SPACE SPIDER CRANE Patent Application
IAN O. MACCONOCHIE, inventor (to NASA), JACK E. PENNINGTON, inventor (to NASA), CHARLES F. BRYAN, JR., inventor (to NASA), MARTIN M. MIKULAS, JR., inventor (to NASA), and REBECCA L. KINKEAD, inventor (to NASA) 30 Sep. 1986 18 p
(NASA-CASE-LAR-13411-1SB; NAS 1.71:LAR-13411-1; US-PATENT-APPL-SN-913432) Avail: NTIS HC A02/MF A01 CSCL 84G
A space spider crane for the movement, placement, and/or assembly of various components on or in the vicinity of a space structure is described. As permanent space structures are utilized by the space program, a means will be required to transport cargo and perform various repair tasks. A space spider crane comprising a small central body with attached manipulators and legs fulfills this requirement. The manipulators may be equipped with constant pressure gripping end effectors or tools to accomplish various repair tasks. The legs are also equipped with constant pressure gripping end effectors to grip the space structure. Control of the space spider crane may be achieved either by computer software or a remotely situated human operator, who maintains visual contact via television cameras mounted on the space spider crane. One possible walking program consists of a parallel motion walking program whereby the small central body alternatively leans forward and backward relative to end effectors. NASA

N87-15904# Committee on Commerce, Science, and Transportation (U.S. Senate).
NASA AUTHORIZATIONS, FISCAL YEAR 1987
Washington GPO 1987 500 p Hearings before the Subcommittee on Science, Technology and Space of the Committee on Commerce, Science and Transportation, 99th Congress, 2d Session, 20 Mar.; 10, 16, 23 Apr.; 8 May; 5 Aug. 1986
(GPO-61-975) Avail: Subcommittee on Science, Technology and Space
NASA's FY-1987 Aeronautics and Transatmospherics Research and Technology budget requests are examined. The Advanced Turboprop Program, rotorcraft programs, the X-wing Program, long-distance supersonic cruise research, scramjet engine development, and aerospace plane technology development are addressed. M.G.

N87-15905# Committee on Science and Technology (U.S. House).
H.R. 4316 AND H.R. 3112: INVENTIONS IN OUTER SPACE
Washington GPO 1986 97 p Hearing on H.R. 4316 and H.R. 3112 before the Subcommittee on Space Science and Applications of the Committee on Science and Technology, 99th Congress, 2d Session, No. 148, 12 Aug. 1986
(GPO-64-526) Avail: Subcommittee on Space Science and Applications
Comments and prepared statements concerning two pieces of legislation, H.R. 4316 and H.R. 3112, are presented. These bills amend title 35 of the United States Code and the National Aeronautics and Space Act with respect to the applicability of the U.S. patent law to activities which occur in outer space. Topics of major concern include the clarification of jurisdiction, the relationship between U.S. federal agencies and their inventor contractors, and international cooperative agreements. Representatives from NASA, the Patent and Trademark Office, and private industry presented testimony. M.G.

N87-16654* National Aeronautics and Space Administration, Washington, D.C.
NASA PATENT ABSTRACTS BIBLIOGRAPHY: A CONTINUING BIBLIOGRAPHY. SECTION 1: ABSTRACTS (SUPPLEMENT 30)
Jan. 1987 50 p
(NASA-SP-7039(30)-SECT-1; NAS 1.21:7039(30)-SECT-1) Avail: NTIS HC A03 CSCL 05B
Abstracts are provided for 105 patents and patent applications entered into the NASA scientific and technical information system during the period July 1986 through December 1986. Each entry consists of a citation, an abstract, and in most cases, a key illustration selected from the patent or patent application. Author

N87-17799*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
BUDGET AVAILABILITY
KELLEY J. CYR *In* NASA. Marshall Space Flight Center Manned Mars Mission. Working Group Papers, V. 2, Sect. 5, App. p 929-935 May 1986
Avail: NTIS HC A24/MF A01 CSCL 05C
A forecast of the total NASA budget required to achieve a manned mission to Mars at around the end of this century is described. A methodology is presented for projecting the major components of the NASA budget, including the NASA base, space flight, space station, Shuttle Derived Launch Vehicle, and the Manned Mars Mission. The NASA base, including administrative expenses, construction of facilities and research and development other than manned flight, is assumed to level off at the present (1985) level and remain constant at approximately $3.5 billion (constant fiscal year 1985 dollars). The budget for space flight, which consists of Shuttle research and development, operations, and tracking and data acquisition costs, is projected to decrease from approximately $4 billion in 1985 to just under $2.5 billion by 1989 and then level off. Planning profiles for three major programs are constructed: a permanently manned space station; a Shuttle Derived Vehicle; and a Manned Mars Mission. It is concluded that

all of the programs can be conducted by the year 2002 with a 3 percent real growth rate in the NASA budget. Author

N87-18459* National Aeronautics and Space Administration, Washington, D.C.
NASA PATENT ABSTRACTS BIBLIOGRAPHY: A CONTINUING BIBLIOGRAPHY. SECTION 2: INDEXES (SUPPLEMENT 30)
Jan. 1987 493 p
(NASA-SP-7039(30)-SECT-2; NAS 1.21:7039(30)-SECT-2) Avail: NTIS HC A21 CSCL 05B

A subject index is provided for over 4500 patents and patent applications for the period May 1969 through December 1986. Additional indexes list personal authors, corporate authors, contract numbers, NASA case numbers, U.S. patent class numbers, U.S. patent numbers, and NASA accession numbers. Author

N87-21754# Office of Technology Assessment, Washington, D.C.
SPACE STATIONS AND THE LAW: SELECTED LEGAL ISSUES
Sep. 1986 88 p
(PB87-118220; OTA-BP-ISC-41; LC-86-600569) Avail: NTIS HC A05/MF A01 CSCL 05D

Part 1 is a background paper which discusses the legal consequences of developing and operating the space station. This paper examines the different ways in which a multinational space station might be owned and operated and explains how each could affect the rights and responsibilities of the U.S. Government and its citizens. In addition, it gives special attention to the application of jurisdiction, tort law, intellectual property, and criminal law to nations and individuals living and working in space. Part 2 of this report is a summary of the workshop held by OTA to critique and expand on the initial drafts of Part 1. GRA

N87-22560# Committee on Appropriations (U.S. House).
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT-INDEPENDENT AGENCIES APPROPRIATIONS FOR 1988
Washington GPO 1987 1031 p Hearings before the Subcommittee on HUD-Independent Agencies of the Committee on Appropriations, 100th Congress, 1st Session, 7 Apr. 1987
(GPO-73-418) Avail: Subcommittee on HUD-Independent Agencies

The Federal Budget requests by the National Aeronautics and Space Administration for the Fiscal Year 1988 are discussed. These requests cover the expenditure for returning the Shuttle to flight status; commitments to the space station; space science and applications; space research and technology; space tracking and data systems; institutional programs; and construction and maintenance. B.G.

N87-24240# Committee on Commerce, Science, and Transportation (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION ACT
Washington GPO 1987 47 p A bill, S. 1164, referred to the Committee on Commerce, Science and Transportation, 100th Congress, 1st Session, 7 May 1987
(S-REPT-100-87) Avail: US Capitol, Senate Document Room

Appropriations for the National Aeronautics and Space Administration for research and development, space flight, control and data communication, construction of facilities, and research and program management are discussed. B.G.

N87-24242# Committee on Appropriations (U.S. House).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
In its Department of Housing and Urban Development - Independent Agencies Appropriations Bill, 1988 p 39-43 25 Jun. 1987
Avail: Document Room, House of Representatives, Washington, D.C. 20515 HC free

The section of House bill H.R. 2783 which deals with the appropriations for the National Aeronautics and Space Administration is summarized. Appropriations cover research and development, space flight control and data communications, construction of facilities, and research and program management. The 1987 appropriation amounts, 1988 estimates, and the amounts recommended in the bill are provided. M.G.

N87-24243# Committee on Commerce, Science, and Transportation (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION ACT, 1988
Washington GPO 1987 114 p A report on S.1164 submitted by the Committee on Commerce, Science and Transportation, 100th Congress, 1st Session, 24 Jun. 1987
(S-REPT-100-87; GPO-74-470) Avail: US Capitol, Senate Document Room

The major provisions and legislative history of Senate bill S. 1164 authorizing appropriations to the National Aeronautics and Space Administration for research and development, space flight, control and data communications, construction of facilities, and research and program management are summarized. A section-by-section analysis of the bill is also presented. The various amendments to the bill include the language of S. 1173 (the Office of Space Transportation FY-1988 Authorization), S. 502 (Technical Amendments to the Land Remote-Sensing Commercialization Act of 1984), S. 752 (the Space Grant College and Fellowship Program), and others. M.G.

N87-25023* National Aeronautics and Space Administration, Washington, D.C.
NASA PATENT ABSTRACTS BIBLIOGRAPHY: A CONTINUING BIBLIOGRAPHY. SECTION 1: ABSTRACTS (SUPPLEMENT 31)
Jul. 1987 45 p
(NASA-SP-7039(31); NAS 1.21:7039(31)) Avail: NTIS HC A03; NTIS standing order as PB86-911100, $11.50 domestic, $23.00 foreign CSCL 05B

Abstracts are provided for 85 patents and patent applications entered into the NASA scientific and technical information system during the period January 1987 through June 1987. Each entry consists of a citation, an abstract, and in most cases, a key illustration selected from the patent or patent application. Author

N87-25024# Committee on Science, Space and Technology (U.S. House).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION ACT, FISCAL YEAR 1988
Washington GPO 1987 270 p Report on H.R. 2782 presented by the Committee on Science, Space and Technology to the Committee of the Whole House on the State of the Union, 100th Congress, 1st Session, 7 Jul. 1987
(H-REPT-100-204; GPO-69-356) Avail: NTIS HC A12/MF A01

Appropriations to the National Aeronautics and Space Administration (NASA) are reviewed for research and development; space flight, control, and data communications; construction of facilities, and research and development management. B.G.

N87-25880# General Accounting Office, Washington, D. C. National Security and International Affairs Div.
SPACE FUNDING: NASA'S APPROPRIATIONS AND DOD'S FUNDING ESTIMATES FOR SPACE PROGRAMS
Feb. 1987 30 p
(PB87-167888; GAO/NSIAD-87-81-FS; B-226100) Avail: NTIS HC A03/MF A01 CSCL 05A

The report covers the following topics: NASA's space funding; DOD's space funding estimates; Comparison of NASA's appropriations and DOD's space funding estimates; Tables; Figures; and Abbreviations. GRA

N87-26689* National Aeronautics and Space Administration, Washington, D.C.
NASA PATENT ABSTRACTS BIBLIOGRAPHY: A CONTINUING BIBLIOGRAPHY. SECTION 2: INDEXES (SUPPLEMENT 31)
Jul. 1987 493 p
(NASA-SP-7039(31)-SECT-2; NAS 1.21:7039(31)-SECT-2) Avail: NTIS HC A21 CSCL 05B

A subject index is provided for over 4600 patents and patent applications for the period May 1969 through June 1987. Additional indexes list personal authors, corporate authors, contract numbers, NASA case numbers, U.S. patent class numbers, and NASA accession numbers. Author

N87-27070# RAND Corp., Santa Monica, Calif.
ISSUES IN INTERNATIONAL TELECOMMUNICATIONS: GOVERNMENT REGULATION OF COMSAT
LELAND L. JOHNSON Jan. 1987 70 p Sponsored by The John and Mary R. Markle Foundation
(R-3497-MF; ISBN-0-8330-0798-X) Avail: NTIS HC A04/MF A01

The history of government regulations are traced. The difficulties of designing and enforcing an effective regulatory scheme is discussed and whether regulation should be restructured or abandoned within the rapidly changing economic environment is evaluated. B.G.

N87-28468# King Research, Inc., Rockville, Md.
COST-BENEFIT ANALYSIS OF US COPYRIGHT FORMALITIES Final Report, 1984-1985
D. W. KING, R. R. V. WIEDERKEHR, and M. K. YATES Feb. 1987 168 p Sponsored by Library of Congress, Washington, D.C.
(PB87-183620) Avail: NTIS HC A08/MF A01 CSCL 05D

The costs and benefits of the U.S. system of copyright formalities were investigated. The copyright formalities of interest are copyright notice, deposit, registration, and recordation. Notice refers to the requirement that a published work contains a copyright notice. Deposit is the requirement that one or more copies of the work be deposited with the Library of Congress. Registration itself is the procedure in which the basic facts of ownership (copyright) are placed on public record. Finally, recordation is the process whereby a public record is maintained by the Copyfight Office of transfers or changes in ownership rights. A conceptual framework was developed to address the volume, costs and benefits of activities related to the four formalities. Thus at the conclusion of the study there would be a basis for comparing all the formalities costs bases on transaction quantities or volume, and their effectiveness in terms of the consequences of them. A second objective of the study was to compare the U.S. system of formalities with those of formality-like systems in England, Sweden, and France. GRA

N87-30219# Committee on Appropriations (U.S. Senate).
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT - INDEPENDENT AGENCIES APPROPRIATION BILL, 1988
WILLIAM PROXMIRE Washington GPO 6 Oct. 1987 117 p Report to accompany H.R. 2783 presented by the Committee on Appropriations, 100th Congr., 1st Sess., 6 Oct. 1987
(S-REPT-100-192) Avail: NTIS HC A06/MF A01

Budget authority for the Department of Housing and Urban Development, the Veterans Administration, the National Aeronautics and Space Administration, the Environmental Protection Agency, The National Science Foundation, and other agencies, commissions, boards, corporations, institutes, and offices is discussed.

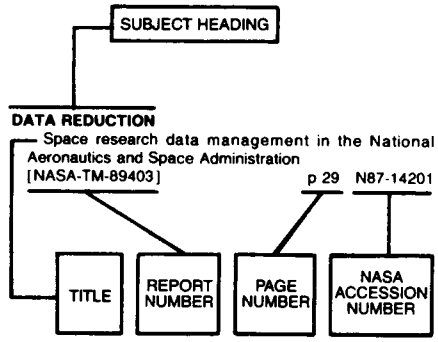
N87-30220# Committee on Appropriations (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
In its Department of Housing and Urban Development - Independent Agencies Appropriation Bill, 1988 p 64-73 6 Oct. 1987
Avail: NTIS HC A06/MF A01

The objectives of the NASA program of research and development are to extend the knowledge of the Earth, its space environment, and the universe; to expand the practical applications of space technology; to develop, operate, and improve unmanned space vehicles; to provide technology for improving the performance of aeronautical vehicles while minimizing the environmental effects and energy consumption; and to assure continued development of the aeronautics and space technology necessary to accomplish national goals. The appropriations necessary to accomplish these goals are examined. B.G.

N87-30221# Committee on Commerce, Science, and Transportation (U.S. Senate).
NASA AUTHORIZATION: AUTHORIZATION OF APPROPRIATIONS FOR THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION FOR FISCAL YEAR 1988
Washington GPO 1987 471 p Hearings on S-Hrg-100-231 before the Subcommittee on Science, Technology and Space of the Committee on Commerce, Science and Transportation, 100th Congress, 1st Session, 3, 19, 26 Feb.; 5 Mar. and 29 Apr. 1987
(GPO-73-245) Avail: NTIS HC A20/MF A01

Appropriations for the FY88 budget for NASA are examined. Prioritization of the four upcoming planetary missions-Galileo, Ulysses, Magellan, and the Mars Observer is discussed. Obstacles which delay the return of the shuttles to service and which delay the building of the space station are also discussed. B.G.

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

A

B

C

D

E

F

G

H

I

J

M

N

O

P

Q

R

S

T

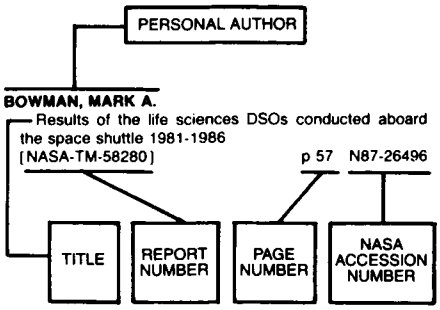
U

V

W

X

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document listed (e.g., NASA report, translation, NASA contractor report). The page and accession numbers are located beneath and to the right of the title. Under any one author's name the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

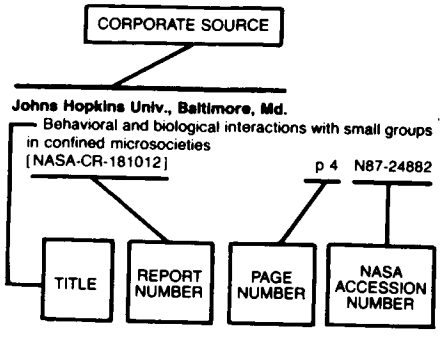
U

V

W

Y

Typical Corporate Source Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document.

A

B

C

SOURCE

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

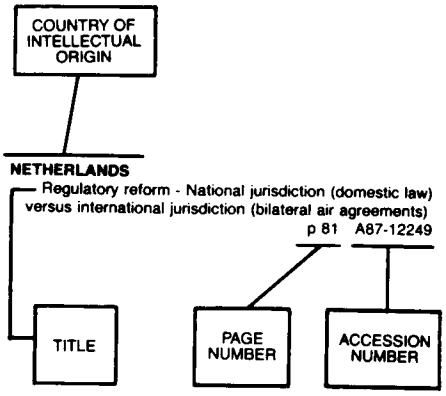
U

V

W

Y

Typical Foreign Technology Index Listing



Listings in this index are arranged alphabetically by country of intellectual origin. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the citation in the abstract section.

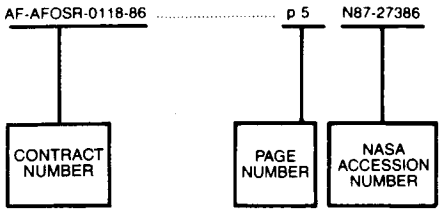
FOREIGN

P

S

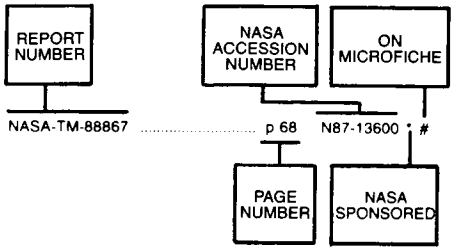
U

Typical Contract Number Index Listing



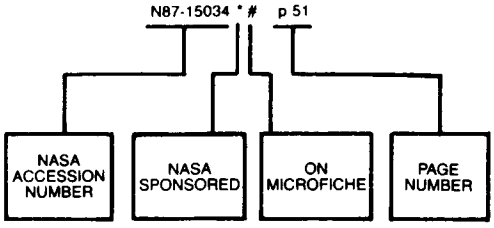
Listings in this index are arranged alpha-numerically by contract number. Under each contract number, the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order with the AIAA accession numbers appearing first. The accession number denotes the number by which the citation is identified in the abstract section. Preceding the accession number is the page number on which the citation may be found.

Typical Report Number Index Listing



Listings in this index are arranged alpha-numerically by report number. The page number indicates the page on which the citation is located. The accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

Typical Accession Number Index Listing



Listings in this index are arranged alpha-numerically by accession number. The page number listed to the right indicates the page on which the citation is located. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

AVAILABILITY OF CITED PUBLICATIONS

IAA ENTRIES (A87-10000 Series)

Publications announced in *IAA* are available from the AIAA Technical Information Service as follows: Paper copies of accessions are available at $10.00 per document (up to 50 pages), additional pages $0.25 each. Microfiche[1] of documents announced in *IAA* are available at the rate of $4.00 per microfiche on demand. Standing order microfiche are available at the rate of $1.45 per microfiche for *IAA* source documents and $1.75 per microfiche for AIAA meeting papers.

Minimum air-mail postage to foreign countries is $2.50. All foreign orders are shipped on payment of pro-forma invoices.

All inquiries and requests should be addressed to: Technical Information Service, American Institute of Aeronautics and Astronautics, 555 West 57th Street, New York, NY 10019. Please refer to the accession number when requesting publications.

STAR ENTRIES (N87-10000 Series)

One or more sources from which a document announced in *STAR* is available to the public is ordinarily given on the last line of the citation. The most commonly indicated sources and their acronyms or abbreviations are listed below. If the publication is available from a source other than those listed, the publisher and his address will be displayed on the availability line or in combination with the corporate source line.

Avail: NTIS. Sold by the National Technical Information Service. Prices for hard copy (HC) and microfiche (MF) are indicated by a price code preceded by the letters HC or MF in the *STAR* citation. Current values for the price codes are given in the tables on NTIS PRICE SCHEDULES.

Documents on microfiche are designated by a pound sign (#) following the accession number. The pound sign is used without regard to the source or quality of the microfiche.

Initially distributed microfiche under the NTIS SRIM (Selected Research in Microfiche) is available at greatly reduced unit prices. For this service and for information concerning subscription to NASA printed reports, consult the NTIS Subscription Section, Springfield, Va. 22161.

NOTE ON ORDERING DOCUMENTS: When ordering NASA publications (those followed by the * symbol), use the N accession number. NASA patent applications (only the specifications are offered) should be ordered by the US-Patent-Appl-SN number. Non-NASA publications (no asterisk) should be ordered by the AD, PB, or other *report* number shown on the last line of the citation, not by the N accession number. It is also advisable to cite the title and other bibliographic identification.

Avail: SOD (or GPO). Sold by the Superintendent of Documents, U.S. Government Printing Office, in hard copy. The current price and order number are given following the availability line. (NTIS will fill microfiche requests, as indicated above, for those documents identified by a # symbol.)

(1) A microfiche is a transparent sheet of film, 105 by 148 mm in size containing as many as 60 to 98 pages of information reduced to micro images (not to exceed 26.1 reduction).

Avail: BLL (formerly NLL): British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England. Photocopies available from this organization at the price shown. (If none is given, inquiry should be addressed to the BLL.)

Avail: DOE Depository Libraries. Organizations in U.S. cities and abroad that maintain collections of Department of Energy reports, usually in microfiche form, are listed in *Energy Research Abstracts.* Services available from the DOE and its depositories are described in a booklet, *DOE Technical Information Center - Its Functions and Services* (TID-4660), which may be obtained without charge from the DOE Technical Information Center.

Avail: ESDU. Pricing information on specific data, computer programs, and details on ESDU topic categories can be obtained from ESDU International Ltd. Requesters in North America should use the Virginia address while all other requesters should use the London address, both of which are on the page titled ADDRESSES OF ORGANIZATIONS.

Avail: Fachinformationszentrum, Karlsruhe. Sold by the Fachinformationszentrum Energie, Physik, Mathematik GMBH, Eggenstein Leopoldshafen, Federal Republic of Germany, at the price shown in deutschmarks (DM).

Avail: HMSO. Publications of Her Majesty's Stationery Office are sold in the U.S. by Pendragon House, Inc. (PHI), Redwood City, California. The U.S. price (including a service and mailing charge) is given, or a conversion table may be obtained from PHI.

Avail: NASA Public Document Rooms. Documents so indicated may be examined at or purchased from the National Aeronautics and Space Administration, Public Documents Room (Room 126), 600 Independence Ave., S.W., Washington, D.C. 20546, or public document rooms located at each of the NASA research centers, the NASA Space Technology Laboratories, and the NASA Pasadena Office at the Jet Propulsion Laboratory.

Avail: Univ. Microfilms. Documents so indicated are dissertations selected from *Dissertation Abstracts* and are sold by University Microfilms as xerographic copy (HC) and microfilm. All requests should cite the author and the Order Number as they appear in the citation.

Avail: US Patent and Trademark Office. Sold by Commissioner of Patents and Trademarks, U.S. Patent and Trademark Office, at the standard price of $1.50 each, postage free. (See discussion of NASA patents and patent applications below.)

Avail: (US Sales Only). These foreign documents are available to users within the United States from the National Technical Information Service (NTIS). They are available to users outside the United States through the International Nuclear Information Service (INIS) representative in their country, or by applying directly to the issuing organization.

Avail: USGS. Originals of many reports from the U.S. Geological Survey, which may contain color illustrations, or otherwise may not have the quality of illustrations preserved in the microfiche or facsimile reproduction, may be examined by the public at the libraries of the USGS field offices whose addresses are listed in this Introduction. The libraries may be queried concerning the availability of specific documents and the possible utilization of local copying services, such as color reproduction.

Avail: Issuing Activity, or Corporate Author, or no indication of availability. Inquiries as to the availability of these documents should be addressed to the organization shown in the citation as the corporate author of the document.

PUBLIC COLLECTIONS OF NASA DOCUMENTS

DOMESTIC: NASA and NASA-sponsored documents and a large number of aerospace publications are available to the public for reference purposes at the library maintained by the American Institute of Aeronautics and Astronautics, Technical Information Service, 555 West 57th Street, 12th Floor, New York, New York 10019.

EUROPEAN: An extensive collection of NASA and NASA-sponsored publications is maintained by the British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England for public access. The British Library Lending Division also has available many of the non-NASA publications cited in *STAR*. European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents, those identified by both the symbols # and * from ESA – Information Retrieval Service European Space Agency, 8-10 rue Mario-Nikis, 75738 CEDEX 15, France.

FEDERAL DEPOSITORY LIBRARY PROGRAM

In order to provide the general public with greater access to U.S. Government publications, Congress established the Federal Depository Library Program under the Government Printing Office (GPO), with 50 regional depositories responsible for permanent retention of material, inter-library loan, and reference services. At least one copy of nearly every NASA and NASA-sponsored publication, either in printed or microfiche format, is received and retained by the 50 regional depositories. A list of the regional GPO libraries, arranged alphabetically by state, appears on the inside back cover. These libraries are *not* sales outlets. A local library can contact a Regional Depository to help locate specific reports, or direct contact may be made by an individual.

ADDRESSES OF ORGANIZATIONS

American Institute of Aeronautics and Astronautics
Technical Information Service
555 West 57th Street, 12th Floor
New York, New York 10019

British Library Lending Division,
Boston Spa, Wetherby, Yorkshire,
England

Commissioner of Patents and Trademarks
U.S. Patent and Trademark Office
Washington, D.C. 20231

Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, Tennessee 37830

ESA-Information Retrieval Service
ESRIN
Via Galileo Galilei
00044 Frascati (Rome) Italy

ESDU International, Ltd.
1495 Chain Bridge Road
McLean, Virginia 22101

ESDU International, Ltd.
251-259 Regent Street
London, W1R 7AD, England

Fachinformationszentrum Energie, Physik, Mathematik GMBH
7514 Eggenstein Leopoldshafen
Federal Republic of Germany

Her Majesty's Stationery Office
P.O. Box 569, S.E. 1
London, England

NASA Scientific and Technical Information Facility
P.O. Box 8757
B.W.I. Airport, Maryland 21240

National Aeronautics and Space Administration
Scientific and Technical Information Division (NTT-1)
Washington, D.C. 20546

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Pendragon House, Inc.
899 Broadway Avenue
Redwood City, California 94063

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

University Microfilms
A Xerox Company
300 North Zeeb Road
Ann Arbor, Michigan 48106

University Microfilms, Ltd.
Tylers Green
London, England

U.S. Geological Survey Library
National Center - MS 950
12201 Sunrise Valley Drive
Reston, Virginia 22092

U.S. Geological Survey Library
2255 North Gemini Drive
Flagstaff, Arizona 86001

U.S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025

U.S. Geological Survey Library
Box 25046
Denver Federal Center, MS914
Denver, Colorado 80225

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA SP-7500 (22)		

4. Title and Subtitle	5. Report Date
MANAGEMENT A Bibliography for NASA Managers	April, 1988
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
9. Performing Organization Name and Address National Aeronautics and Space Administration Washington, DC 20546	10. Work Unit No.
	11. Contract or Grant No.
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This bibliography lists 653 reports, articles and other documents introduced into the NASA scientific and technical information system in 1987. Items are selected and grouped according to their usefulness to the manager as manager. Citations are grouped into ten subject categories: human factors and personnel issues; management theory and techniques; industrial management and manufacturing; robotics and expert systems; computers and information management; research and development; economics, costs, and markets; logistics and operations management; reliability and quality control; and legality, legislation, and policy.

17. Key Words (Suggested by Authors(s))	18. Distribution Statement
Bibliographies Management Management Methods Management Planning	Unclassified - Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price *
Unclassified	Unclassified	162	A08

*For sale by the National Technical Information Service, Springfield, Virginia 22161 NASA-Langley, 1988